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VOL. CXXXVII.—No. 3567] LONDON: FRIDAY EVENING, MAY 9, 1924 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, REQUIRES:

1. SLUICE GATES, 60ft. by 15ft., and Gear No. 24.
2. CAST IRON PIPES, 7in. and 5in. diam.

Tenders due on the 27th May, 1924, for No. 1, and on the 22nd May, 1924, for No. 2.
Tender forms obtainable from above. 5717

G. R.

BY DIRECTION OF THE SURPLUS STORES, &c., LIQUIDATION DEPARTMENT, TREASURY.

The Department would Draw THE ATTENTION OF MANUFACTURERS, ENGINEERS AND ALL OTHERS SEEKING FACTORY PREMISES,

to the fact that they have for disposal

FACTORY PREMISES

in certain INDUSTRIAL AREAS OF ENGLAND AND SCOTLAND

suitable for the establishment of ENGINEERING WORKS, CHEMICAL WORKS, WORKS OR MILLS REQUIRING A PLENTIFUL WATER SUPPLY, and WORKS FOR LIGHT OR HEAVY MANUFACTURE.

The floor space varies from 4,000 square feet to 500,000 square feet, and most of the Factories have RAILWAY FACILITIES and some have CANAL and RIVER FRONTAGES.

Also FREEHOLD FACTORY SITES FOR SALE with areas varying from 5 to 200 ACRES.

Will applicants state their specific requirements and apply for full particulars to The Chief Valuer, Surplus Stores, &c., Liquidation Department, Treasury, Room 230, Caxton House, Tothill Street, London, S.W.1. 5584

University of Sheffield.
COURSES IN MECHANICAL ENGINEERING.

Professor F. C. LEA, D.Sc., M. Inst. C.E., M.I.Mech.E., Professor of Mechanical Engineering.

DEGREE, ASSOCIATESHIP and WORKS PUPILS' COURSES.

Applications are also invited from those desiring to do Research Work in Engineering.

Full particulars may be obtained from Professor Lea, Department of Applied Science, 84, George's-square, Sheffield.

W. M. GIBBONS, Registrar.

5590

The University of Manchester.

APPLICATIONS are INVITED for the POST of ASSISTANT LECTURER in ENGINEERING. Stipend, £300 per annum.

Candidates should have some Civil Engineering Experience and be able to give assistance in the Surveying Field Courses.

Applications should be sent to the INTERNAL REGISTRAR not later than 21st June. Further particulars may be obtained on application to the Internal Registrar. 5625

Aberdeen Corporation Water-Works.
EXTENSIONS, 1920.
CONTRACT NO. 19.—PIPE LAYING.

The Town Council of Aberdeen are prepared to receive TENDERS from competent persons willing to enter into a contract for the TRANSPORTING, LAYING, and JOINTING of about 5560 LINEAL YARDS of CAST IRON PIPES from 30in. to 13in. in diameter, and ANCILLARY WORKS in and near the City of Aberdeen.

The drawings may be inspected and specification, schedule of quantities and form of Tender obtained on and after 2nd May, 1924, on application at the Water Engineer's Office, 41½, Union-street, Aberdeen. Early application is desirable, and no specification will be given out after 12th May.

For each specification a deposit of Five Pounds sterling will be required, which sum will, after a Tender has been accepted, be returned to the tenderer, provided that he shall have sent in a bona fide Tender, based on the drawings, specification, and schedule of quantities provided, with the schedule of quantities fully priced out in detail, and shall not have withdrawn the same.

The employment of labour shall be in accordance with the conditions of the Unemployment Grants Committee.

Tenders, on the forms prescribed and enclosed in securely sealed envelopes, endorsed "Tender for Pipe Laying," are to be addressed to the undersigned. No Tender delivered after Twelve Noon on 19th May, 1924, will be considered.

The Town Council do not bind themselves to accept the lowest or any Tender.

GEORGE MITCHELL, M. Inst. C.E., F.G.S., Water Engineer's Office: 41½, Union-street, Aberdeen, 29th April, 1924. 5647

East Indian Railway.

The Directors are prepared to receive up to 11 a.m. on Wednesday, the 25th June proximo, TENDERS for the SUPPLY of—

GIRDER BRIDGES.

Copies of the specification can be obtained at the Company's offices on payment of £1 1s. each. This fee will not be returned.

G. R. LILLIE, Secretary.

73-76, King William-street, London, E.C. 4, 7th May, 1924. 5705

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

The British Empire Exhibition (Third Notice).

The Dry-Cooling of Coke.

Iron and Steel Institute—Presidential Address.

Some Large Dutch Drainage Pumps.

Experimental Work on Diesel Engines.

The Marseillaise in Industry.

A Boiler Flue Cleaning Plant.

New Kilovolt-Ampère Demand Meter.

Laying a High-Tension Cable under Water.

PUBLIC NOTICES

Aberdeen Corporation Electri-City.
CITY DEPARTMENT.
CIRCULATING WATER SYSTEM.

The Town Council of Aberdeen are prepared to receive TENDERS for the EXCAVATING, PIPE LAYING and CONCRETE WORK, &c., required in connection with the extension of the Circulating Water System of the Ferryhill Power Station.

Specification, drawings and form of Tender may be obtained from the undersigned on payment of a deposit of £3 3s., which will be refunded after receipt of a bona fide Tender and the return of all documents and drawings.

Extra copies of the specification may be obtained on payment of 10s. per copy, which will not be returnable.

Sealed Tenders, endorsed "Circulating Water System," to be addressed to the City Electrical Engineer, and delivered at his office, Millburn-street, Aberdeen, not later than 1 p.m. on Wednesday, the 21st May, 1924.

The Town Council do not bind themselves to accept the lowest or any Tender.

J. ALEX. BELL, City Electrical Engineer.

1st May, 1924. 5676

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for
(a) MILD STEEL PLATES and FLATS.
(b) MILD STEEL ANGLES.

Specifications and forms of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, E.C. 2, on or after 7th May, 1924.

A fee of 20s. will be charged for Specification (a) and 10s. for (b), which are NOT returnable.

Tenders must be submitted not later than Noon on Wednesday, 21st May, 1924.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the orders.

By Order of the Board, R. V. VOLKERS, Secretary.

5688

City of Liverpool.
TRAMWAY MATERIAL.

The Corporation are prepared to receive TENDERS for the SUPPLY and DELIVERY of various classes of TRAMWAY MATERIAL, as under:—

Schedule No. 1.—Steel Tramway Rails and Fish-plates.
Schedule No. 2.—Steel Fish-bolts.
Schedule No. 3.—Steel Tie-bars.
Schedule No. 4.—Copper Bonds.

Firms are required to state clearly, when making application for the necessary Tender forms, the name and number of the schedule for which they desire to be furnished with Tender form.

Duplicate forms of Tender for record purposes will NOT be supplied.

Tender forms will be forwarded UPON RECEIPT OF APPLICATION IN WRITING to:—

The City Engineer, Municipal Buildings, Dale-street, Liverpool.

Tenders must be sealed and enclosed in the official envelopes provided, endorsed in accordance with the instructions given on the form of Tender, and FORWARDED THROUGH THE POST, addressed to:—"The Town Clerk, Municipal Buildings, Liverpool." LATEST TIME AND DATE FOR RECEIPT OF TENDERS:—

TEN O'CLOCK A.M. ON FRIDAY, THE 23RD MAY, 1924.

WALTER MOON, Town Clerk.

1st May, 1924. 5662

PUBLIC NOTICES

Bungay Urban District Council.
WATERWORKS PUMPING MACHINERY.

The above Council invite TENDERS for the SUPPLY, ERECTION, and FIXING of TWO CRUDE OIL ENGINES of 17 B.H.P., and TWO VERTICAL TREBLE-RAM PUMPS of 7500 gallons per hour capacity.

Specification, schedule of prices, and form of Tender may be obtained on application to the Engineers, Messrs. Taylor and Wallin, Commercial Union Buildings, 47, Pilgrim-street, Newcastle-on-Tyne, on payment of £5 deposit, which sum will be returned on receipt of a bona fide Tender and the documents lent to the contractor for the purpose of preparing his Tender.

Sealed Tenders, endorsed "Pumping Machinery," on the prescribed form, with the schedule of prices properly filled in, must be delivered to me, the undersigned, at my office not later than Monday, May the 26th, 1924.

The Council do not bind themselves to accept the lowest or any Tender.

PERCY J. SPRAKE, Clerk to Urban District Council.

Broad-street, Bungay, Suffolk, May, 1924. 5713

Great Northern Railway (Ireland).
TO BUILDING CONTRACTORS.

The Directors are prepared to receive TENDERS for ERECTION of an ENGINE SHED, in Reinforced Concrete, at Clones Station.

The drawings and specification may be inspected at the Engineer's Offices, Dublin and Belfast, and copies of same, together with bill of quantities and form of Tender, may be obtained from the undersigned on payment of Two Guineas, which will be refunded on receipt of a bona fide Tender and return of the drawings.

Tenders made out on the forms supplied by the Company should be delivered under sealed cover, endorsed "Tender for Engine Shed," not later than 10 a.m. on Friday, 23rd May, 1924.

The Directors do not bind themselves to accept the lowest or any Tender.

J. B. STEPHENS, Secretary.

Amiens-street Station, Dublin, 1st May, 1924. 5673

Torquay Town Council.
WATERWORKS DEPARTMENT.

The Council of the Borough of Torquay is prepared to receive TENDERS for the CONSTRUCTION of a SERVICE RESERVOIR and Ancillary Works, at Great Hill, Torquay.

The reservoir is to be constructed of mass concrete, with brick lining, and will have a reinforced concrete roof supported on brick piers. The capacity of the reservoir will be approximately 1,500,000 gallons.

Specifications and schedules may be obtained on application to the undersigned on payment of a deposit of Two Guineas, which will be returned on receipt of a bona fide Tender.

Sealed Tenders, endorsed "Tender for Service Reservoir—Contract 12," together with specification and schedule of prices, must be delivered to the Town Clerk at his office, Town Hall, Torquay, before Noon, Tuesday, 20th May, 1924.

The Council does not bind itself to accept the lowest or any offer.

SAMUEL C. CHAPMAN, M. Inst. C.E., Waterworks Engineer.

Town Hall, Torquay, 5th May, 1924. 5677

PUBLIC NOTICES

Metropolitan Water Board.
MAIN, KEMPTON TO CRICKLEWOOD.
TENDERS FOR SECTION NO. 2.

LAYING 48in. CAST IRON MAIN AND CONTINGENT WORKS FROM GREENFORD TO CRICKLEWOOD AND THE LAYING OF 27in. CAST IRON PIPES FROM NEAR HANGER-LANE TO EALING.

The Metropolitan Water Board invite TENDERS for the LAYING and JOINTING of about 5445 YARDS of 48in. diameter CAST IRON WATER MAIN, principally through fields, and also the LAYING of about 1620 YARDS of 52in. STEEL PIPES, mainly in subways, from Windmill-lane, north of the Board's existing Valve House, in the Parish of Greenford, to the Board's Works at Cricklewood, in the Parish of Willesden, together with about 1447 YARDS of 27in. diameter CAST IRON MAIN, branching from the 48in. diameter main near Hanger-lane, in the Parish of Wembley, and extending to the neighbourhood of the Board's Fox Reservoir, in the Parish of Ealing, all in the County of Middlesex.

Drawings, conditions of contract and specifications may be inspected without payment of a fee at the Offices of the Board, Chief Engineer's Department (Room 201), on and after 14th May, 1924.

Form of Tender, conditions of contract, specification, bills of quantities and schedules of prices, together with drawings and a spare copy of the bills of quantities and schedules of prices, may be obtained on and after 19th May, 1924, from Mr. Henry E. Stillgoe, M. Inst. C.E., the Chief Engineer, on production of an official receipt for the sum of £20, which sum must be deposited with the Accountant to the Board, and will be returned on receipt of a bona fide Tender, accompanied by all the above-named documents and drawings (with the exception of the spare copy of the bills of quantities and schedules of prices, which may be retained by the tenderer). Such payments and applications must be made between the hours of 10 a.m. and 4.30 p.m. (Saturdays, 10 a.m. and 12 noon). Cheques must be made payable to the "Metropolitan Water Board" and not to individuals.

Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board, Metropolitan Water Board, New River Head, Clerkenwell, E.C. 1," and endorsed "Tender for Main, Kempton to Cricklewood, Section No. 2," must be delivered at the Offices of the Board (Room 123) not later than 10 a.m. on Thursday, 5th June, 1924.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER, Clerk of the Board.

Offices of the Board: New River Head, Clerkenwell, E.C. 1, 6th May, 1924. 5703

Port of Bristol.
NEW ELECTRIC CRANES, BRISTOL CITY DOCKS.

The Docks Committee are prepared to receive TENDERS for the CONSTRUCTION of THREE 2-Ton MOVABLE ELECTRIC JIB CRANES, and the ERECTION of the same on the roof of Shed "U" (now in course of reconstruction), Canon's Marsh, Bristol City Docks.

On and after Tuesday, the 13th day of May, 1924, copies of the general conditions, specification, schedule of prices and contract drawing can be obtained from the undersigned on production of a receipt showing that a deposit of £5 has been paid to the Bristol Docks Committee (to whom all cheques must be made payable), 19, Queen-square, Bristol. The deposit of £5 will be returned hereafter to all bona fide tenderers.

Tenders must be enclosed in a sealed envelope endorsed "Tender for Three Electric Cranes," and addressed to the General Manager and Secretary of the Docks Committee, 19, Queen-square, Bristol, and must be delivered to him, accompanied by all the prescribed documents and drawings, before 10 a.m. on Monday, the 9th day of June, 1924.

The Docks Committee do not bind themselves to accept the lowest or any Tender.

THOMAS A. PEACE, Engineer, Port of Bristol

Chief Engineer's Office, Avonmouth Docks, 9th May, 1924. 5678

Southampton Corporation
WATERWORKS.
TO CONTRACTORS AND OTHERS.

The Corporation invite TENDERS for the LAYING of about 2400 Yards of 4in. CAST IRON MAIN, from Bishop's Waltham to Waltham Chase Cross Roads.

Specification and quantities and form of Tender may be obtained and plans and conditions of contract inspected, at the Waterworks Engineer's Offices, 21, Shirley-road, Southampton.

Sealed Tenders, endorsed "Tender, Waltham Chase Extension," must be delivered at the Town Clerk's Office on or before the 16th instant.

No pledge is given to accept any Tender.

R. R. LINTHORNE, Town Clerk.

2nd May, 1924. 5675

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PUBLIC NOTICES

Royal Burgh of Kirkcaldy.

ELECTRICITY WORKS, VICTORIA-ROAD.

The Provost, Magistrates and Council invite TENDERS for the following work :—

Specification No. 38.—CABLES and ROADWORK.

A copy of the specification and drawings can be seen at, and obtained from, the offices of Messrs. Kennedy and Donkin, 8, Broadway, Westminster, S.W. 1, upon payment of a deposit of £2 2s. (cheque, postal or money order). An additional copy of the specification can be obtained upon payment of a deposit of £1 1s. These deposits will be returned after the receipt of a bona fide Tender, and on the return of the specification.

Tenders on the prescribed form, enclosed in sealed envelopes, and addressed on the outside :—

"Electricity Supply : Tender to Specification No. 38," must be delivered at the office of the undersigned not later than 10 a.m. on Monday, 26th May, 1924.

The Council do not bind themselves to accept the lowest or any Tender.

W. L. MACINDOE, Esq.,
Town Clerk's Office,
Kirkcaldy.

May, 1924. 5692

TO ENGINEERS AND SHIPBUILDERS.

Tenders are Invited for the

CONSTRUCTION and DELIVERY afloat in the River Thames of a SINGLE-SCREW RIVER TUG of the following dimensions :—Length overall, 68ft. 9in.; length B.P., 64ft.; breadth moulded, 14ft. 9in.; depth moulded, 8ft.; draught aft limited to 6ft. 6in., with boiler and condenser full and 4 tons coal on board. To be built of steel to design and specification to be submitted for approval. The following principal scantlings :—Frames, 3in. by 2½in. by 3-8in., spaced 18in. for two-thirds length, amidships, and 15in. at ends; reverse frames, 2½in. by 2½in. by 5-16in. to upper turn of bilge and deck alternately; bulkhead frames, 4in. by 3in. by 7-16in.; plating sheerstrake, 8-20in.; keel plate, 42in. by 8-20in., with outside doubling plate, 18in. by 6-20in.; remainder, 6-20in.; floors, 10in. by 8-20in.; centre keels on double angles, 9in. by 3in. by 3-8in.; intercostal plates, 3-8in.; keel angles, 3in. by 3in. by 3-8in.; side keelsons double, 3in. by 3in. by 3-8in.; deck chequered Admiralty pattern, ⅜in. thick on plain; bulwarks, 26in. high to tumble home 12in. all round and to be well stayed, and doubled round stern bulwarks with 6-20in. plating; main rail, 4in. by 2½in. by 5-16in. bulb angle; rubbing band, 5in. wide double riveted. MACHINERY.—Engines, compound surface condensing, not less than 12in. and 24in. by 18in. stroke, guaranteed to develop 230 I.H.P. at 160 r.p.m.; cast steel propeller, 5ft. 9in. dia., and about 9ft. pitch, four-bladed and having ample surface. BOILER.—Steel, about 9ft. dia., with heating surface about 950 sq. ft., grate area 23 sq. ft., with dome; two furnaces and separate combustion chambers, with all mountings for a working pressure of 160 lb. per sq. inch; funnel to lower on a V joint and cast iron balance weights; pumps, general service pump, Duplex type, with all requisite piping and connections. The whole to be completed with usual outfit for river work and of first-class workmanship and material. Hull and machinery to be at least equal in all respects to Board of Trade and/or Lloyd's Rules, with certificates furnished for same. Tenders to undermentioned, who do not bind themselves to accept the lowest or any Tender.

TOUGH and HENDERSON,
Tug Owners,
53, Upper Ground-street,
5691 Blackfriars, London, S.E. 1.

The South Indian Railway Com-

PANY, LIMITED, are prepared to receive TENDERS for the SUPPLY of—

LAMINATED SPRINGS and SPRING STEEL.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked, "Tender for Laminated Springs and Spring Steel," must be left with the undersigned not later than Twelve Noon on Friday, the 23rd May, 1924.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 5s. for each copy of the specification.

Copies of the drawings may be obtained at the offices of Messrs. Robert White and Partners, Consulting Engineers to the Company, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1,
6th May, 1924. 5706

The Great Indian Peninsula

RAILWAY COMPANY, 48, Copthall-avenue, London, E.C. 2, invite TENDERS for—

1. BELLS, BIB COCKS, &c.	Fee 5s.
2. GALVANISED SHEETS	,, 5s.
3. METALS	,, 5s.
4. BRASS SHEETS and COPPER TUBES	,, 5s.

Tenders are due by 11 a.m. on 20th May, 1924. Tender forms obtainable at above address. Fees not returnable. 5704

Urban District Council of

EAST AND WEST MOLESEY.
SEWAGE WORKS.

The above Council invite TENDERS for OIL ENGINE DRIVEN CENTRIFUGAL PUMPS and COMPRESSORS for the Sewage Works of the Urban District Council of East and West Molesey.

Specification and form of contract can be obtained from the Clerk, Council Offices, East Molesey, Surrey.

Deposit £2 2s.

Sealed Tenders, endorsed "Tender for Engines, Pumps, &c.," must be delivered at the Clerk's office, East Molesey, not later than Twelve o'clock Noon on the 23rd May, 1924.

The Council do not bind themselves to accept the lowest or any Tender.

GORDON CONDELL,
Clerk to the Council.

Council Offices,
St. Mary's-road, East Molesey,
2nd May, 1924. 5665

City of Sheffield.

WATER DEPARTMENT.
CONSTRUCTION OF EWDEN VALLEY RESERVOIRS.
ASSISTANT ENGINEER.

APPLICATIONS are INVITED for the APPOINTMENT of THIRD ASSISTANT ENGINEER in connection with the Construction by direct labour of Two Reservoirs in the Ewden Valley (one of a capacity of 1210 million gallons and the other of 546 million gallons).

Inclusive salary £300 per annum.

Applicants must be properly qualified engineers and have had practical experience in the design and construction of impounding reservoirs (with earth embankments), including the setting out of work and the control of workmen.

The person appointed will be required to enter upon the duties at once, reside upon the works, and devote the whole of his time to the service of the Corporation.

Applications, stating age, qualifications, and experience, accompanied with copies of three recent testimonials, endorsed "Assistant Ewden Engineer," to be sent to me not later than 14th May, 1924.

WILLIAM TERREY,
General Manager.

Town Hall, Sheffield,
7th May, 1924. 5715

Knowle Mental Hospital.

WANTED, a WORKING ASSISTANT ENGINEER, age not exceeding 35 years. Candidates must be qualified Mechanical Engineers, Draughtsmen and Electricians. Salary £260 a year and house, subject to deductions under Asylums Officers' Superannuation Act, 1909.—Applications, stating age and giving full particulars of experience and qualifications, together with copies of recent testimonials, to be sent to the CLERK TO THE VISITING COMMITTEE, Knowle Mental Hospital, Fareham, Hants, not later than the 19th May 1924, marked "Assistant Engineer." 5699

PUBLIC NOTICES

Junior Assistant Engineer for

THE MUNICIPAL CORPORATION OF RANGOON, BURMA.

WANTED, JUNIOR ASSISTANT ENGINEER, primarily to Take Charge of Drawing-office in Water and Sewage Department; must be either a Chartered Civil Engineer or a Corporate Member of the Institution of Municipal and County Engineers (by examination), with not less than three years' previous experience in Supervising, Measuring up for Certificates, and the Preparation of Drawings, Estimates, Specifications, Bills of Quantities for Works of Water Supply, Sewerage and Sewage Disposal. Salary, Rs. 450, rising by annual increments of Rs. 30 to Rs. 600 a month, plus motor car allowance of Rs. 150 a month. Engagement in first instance for five years, first year on probation, during which or at end of which agreement may be terminated by either party giving to the other three months' notice. Free passage; half salary during voyage out. Leave in accordance with Special Leave Rules in Fundamental Rules of Government of India. Provident Fund, to which subscription at rate of 8 1-3 per cent. of salary payable, to which Corporation contributes equal amount. Compound interest allowed. Applications will be received up to 31st May, 1924. For further particulars apply to—

OGILVY GILLANDERS AND CO., Reference R.2283,
Sun Court, 67, Cornhill, London, E.C.,
5669 Agents for the Corporation of Rangoon.

SITUATIONS OPEN

MESSRS. MERZ and McLELLAN Acknowledge with thanks the applications received for the POSITION advertised on March 14th, which HAS NOW BEEN FILLED. 5695 A

WANTED by a Railway Wagon Building and Repairing Company, a capable SMITH; experienced in Wood and Steel-frame Wagons; able to supervise labour and obtain good results. Wages £5 per week, plus bonus and family house.—Address, P9067, The Engineer Office. P9067 A

AN ENGINEER WANTED as Assistant to Managing Director of a London Company; must be familiar with present Machine Shop and Foundry Practice, preferably man now acting as Assistant to Manager of General Engineering Works.

Applicant would have to be responsible for Designing and Estimating Plant and Control Drawing-office.

Age about 30.

Nobody will be considered unless giving age, technical training, works experience, salary required, with two business and one personal reference.

Every application will be treated confidentially.

The position is progressive and holds good prospects for the right man.

Address, P9054, The Engineer Office. P9054 A

ASSISTANT to INSIDE TECHNICAL MANAGER in a Large Shipyard WANTED. State age, experience, salary asked, references, but copies only.—Address, 5672, The Engineer Office. 5672 A

ASSISTANT WORKS MANAGER WANTED by a firm manufacturing Gas and Oil Engines, employing about 700 to 800 men; must have had experience in best methods of production; only a live man required and one prepared to keep workshop hours.—Address, stating salary required and experience, 5712, The Engineer Office. 5712 A

ENGINEERING JOURNAL.—ASSISTANT EDITOR WANTED. Preference given to man with past experience in similar position, capable of writing on New Machinery and Plant and Modern Production Methods.—Address (in confidence), stating qualifications, salary, &c., 5671, The Engineer Office. 5671 A

THE HYDRAULIC ENGINEERING CO., Ltd., Chester, REQUIRE a JUNIOR ASSISTANT to WORKS MANAGER; must have thorough shop experience and good education.—Apply by letter only, stating age, experience, and salary required. 5666 A

SALES MANAGER WANTED by Firm of Refrigerating Engineers; must have a thorough knowledge of the trade, both technical and commercial.—Address, with all particulars, 5696, The Engineer Office. 5696 A

SALESMAN REQUIRED for United Kingdom, with expert knowledge of Abrasives used in Woodworking, Metal and Shoe Trades; good connection essential.—Write, giving full particulars of past experience and salary required, "CASINGS," c.o. Tayler's, Devon House, Great Portland-street, W. 1. P9056 A

WORKS MANAGER.—Competent and Energetic WORKS MANAGER WANTED for Manchester engineering works, manufacturing large variety of small products. State age, experience and salary required.—Address, 5698, The Engineer Office. 5698 A

CHIEF DRAUGHTSMAN for Aircraft Work. State age, experience, and salary required.—Address, 5816, The Engineer Office. 5816 A

CIVIL ENGINEERING DRAUGHTSMAN REQUIRED, temporary appointment, 10 years, engagement, well up in building construction and works generally; able to use level and theodolite, extract quantities and prepare specifications. Salary £4 10s. per week. Suit man 50 to 55.—Address, 5635, The Engineer Office. 5635 A

DRAUGHTSMAN REQUIRED; First-class Experience essential, used to Design of Front and Rear Axles for Touring Cars and Commercial Vehicles.—Apply by letter only, stating age, experience, and salary required, to KIRKSTALL FORGE, Ltd., near Leeds. 5667 A

DRAUGHTSMAN REQUIRED for Large Engineering Works; knowledge of Refrigerating Machinery essential; state age, experience and salary.—Address, 5709, The Engineer Office. 5709 A

DRAUGHTSMAN WANTED by a Firm of General and Mechanical Engineers; must be fully qualified and reliable.—Address, giving full particulars of experience and qualifications and state salary required, 5708, The Engineer Office. 5708 A

DRAUGHTSMAN WANTED in the South Midlands, experienced in the Design of Tar and Pitch Boilers, Tar-spraying and Spreading Machines and Roadmaking Machinery generally. Must be capable of taking responsibility for design.—Address, 5683, The Engineer Office. 5683 A

DRAUGHTSMAN, with Good Experience in the Design of Pumping Machinery, REQUIRED for East Midlands. State age, experience and salary required.—Address, 5693, The Engineer Office. 5693 A

EXPERIENCED DRAUGHTSMAN REQUIRED. Aircraft experience essential. State age, salary required and qualifications.—Reply, Box 656, T. B. BROWNE'S, Advertising Offices, 163, Queen Victoria-street, E.C. 4. 5612 A

WOODWORKERS and ERECTORS for Aircraft Works, N.W. Coast. Good opportunities for competent men.—Address, 5617, The Engineer Office. 5617 A

SITUATIONS WANTED

ADVERTISER (37) SEEKS POSITION of Responsibility where a first-class experience in modern tooling and machining methods, the design, manufacture and sale of highest-grade machine tools, both standard and special purpose, will receive full scope.—Address, P9069, The Engineer Office. P9069 B

A. M.I.C.E. (33), Railway Locomotive Works and A. D.O., charge of locomotive steam sheds, automobile, hydraulic, maintenance, and general engineering experience, used to control of large staffs, wide technical knowledge, urgently DESIRES POST, works or office.—Address, P9035, The Engineer Office. P9035 B

ARE You REQUIRING a First-class MECH. ENGINEER? Advertiser (40) is a public school man and holds a responsible position in large engineering works.—Address, P9075, The Engineer Office. P9075 B

SITUATIONS WANTED (continued)

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PATENTS

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Finsbury Technical College.

THE old "Tech." has many friends, not alone amongst those who knew it in its palmiest days, when Thompson, Perry and Meldola were magnets to draw students from all parts of the world, but amongst later men who studied there under lesser giants. For their old College these men fought stoutly in 1921, and saved it in that year from obliteration, and they are now called upon to renew their efforts if "Finsbury" is to be preserved. It will be recalled that the College has been carried on for the past few years by the help of a grant of £10,000 per annum from the London County Council. That grant will be paid until 1926, but a letter of the Education Officer of the Council to the secretary of the College makes plain that it will be definitely discontinued in that year. The outlook for the College is, therefore, far from bright, and unless there is a marked increase in the number of students we fear it will close its doors. The publicity given to the fact that it was in a precarious position in 1921 was never fully counteracted by the announcement that it was to carry on its useful work, with the result that the number of entrants fell off and so justified the London County Council's decision. If more students enter the college and, above all, if some generous donor can be found to endow it with a few thousands a year, we may venture the hope that the Council would reconsider its decision, and help it at least in some measure. "Finsbury" has not only great traditions to support it; it has admirable equipment for the education of engineers and chemists, and it would indeed be deplorable if it passed out of existence.

Extensions to London's Tubes.

IT is announced that the Underground Railways Company has placed the contracts for the driving of the necessary tunnels in connection with the extension of the City and South London Railway from Clapham Common to Morden. Charles Brand and Son will undertake the construction of the section between Clapham Common and the north end of Tooting Broadway Station, while the second section of the line, from Tooting to Dorset-road, Morden, will be constructed by the Foundation Company, Limited. The cost of the tunnelling work alone is expected to be about £600,000, to which must be added the cost of stations below and above ground, rolling stock, escalators, and passimeters, making a total cost for the complete construction and equipment of the new section of about £3,500,000. Fifteen months are allowed in which to complete the tunnelling work, and if the work be finished to date, it will create a new record for tube tunnelling. It is understood that ten rotary excavators, each of which will be capable of making an advance of from 15ft. to 20ft. per day, are to be employed. Over sixty thousand tons of cast iron segments will be required for the lining of the 4½ miles of tunnels. Another contract for the construction of a new link between the Hampstead and Highgate Railway at Charing Cross and the City and South London Railway at Kennington, has, we learn, been placed with the Metropolitan Tunnel and Public Works Company, Limited, of Westminster. This new section of line will be carried for part of its length under the bed of the river Thames, and will require an excavation of some 130,900 cubic yards of soil. Over 27,000 tons of cast iron segments will be required to complete the work. The cost of making the tunnel will be about £400,000, and the contract allows for its completion within a period of two and a-half years.

London's Electricity Supply.

ON Monday, May 5th, an inquiry, presided over by Sir John Snell and relating to the supply of electricity to London and the home counties, was opened at the Institution of Electrical Engineers. Sir John intimated that the inquiry would proceed daily throughout this week and longer if necessary. It has been provisionally determined by the Electricity Commissioners that an area comprising the City of London, the counties of London and Middlesex, and parts of the counties of Berks., Buckingham, Essex, Hertford, Kent and Surrey, should constitute a separate electricity district; and the inquiry will finally determine the area to be included.

Runaway Colliery Tubs.

AT a meeting of the National Association of Colliery Managers, held in Sheffield on the 3rd inst., the problem of preventing accidents in collieries through the running away of tubs, was discussed at considerable length. The subject was introduced by Mr. I. C. F. Statham, who pointed out that, although accidents in shafts have been almost entirely eliminated, there is no abatement in the failure of haulage ropes and chains. He gave some particulars of the kinetic energy developed by a runaway train of tubs to show that rigid devices placed in the haulages with the idea of checking the tubs were futile. The force of the impact would be such as to smash up the tubs. He advocated a dragging type of device operated by an overspeed governor and special braking arrangements in conjunction with idle anchor ropes. Several of the speakers urged the provision of separate roads for hauling men, and Mr. R. J. Shaw said that he preferred an emergency brake operated by the man in charge, rather than one of the automatic type.

Irregular Movement by a Passenger Train.

THERE was issued last week the report by Major Hall on a collision between a passenger train and part of a goods train which occurred on February 9th on the down line between Eastwood and Hebden Bridge stations on the Lancashire and Yorkshire section of the London, Midland and Scottish Railway. A feature of the case that at once attracts attention is that the goods train consisted of the unusual number of 117 wagons—38 loaded and 79 empty—with a 10-ton brake, weighing in all 810 tons. Whilst running it became uncoupled between the seventy-ninth and eightieth wagon, and the rear portion came to a stand. The front portion was pulled up at the station in advance, and the next step taken was to stop an up passenger train and to detach its engine, which was then run through the section to make sure that the up line had not been fouled. This light engine arrived at the box where the rear part of the goods train was standing, but instead of using it to propel the rear portion forward, a down passenger train was brought forward and its driver told to do so. The latter was given insufficient information as to where the standing brake and wagons were, but he failed to take the necessary precautions and ran smartly into them. The brake and three wagons were derailed and seven wagons altogether were damaged, two of them considerably. No personal or material damage was done to the passenger train. The evidence showed that such use of a passenger train was not uncommon, and Major Hall says that the facts suggested that the men were so familiarised with the use of a passenger train in circumstances of the kind that it did not occur to them to use the light engine.

A New Broadcasting Station.

THE Edinburgh relay station, which was opened on May 1st, is the third relay station of a similar nature erected by the British Broadcasting Company, the two others being those at Plymouth and Sheffield. Four more of these stations are, however, to be erected at Liverpool, Leeds, Bradford, and Hull. The Edinburgh station, which is situated in George-street, transmits on a wave length of 325 m., the transmitting apparatus being placed in a new building built on high ground at Lauriston, which belongs to the University of Edinburgh. Land lines connect the studio with the transmitter in the same way as the London studio is connected with Marconi House.

The Mersey Tunnel Scheme.

AT a meeting of the committee appointed to deal with the proposal to construct a tunnel under the Mersey, which was held on Friday last, Sir Archibald Salvidge gave some particulars of the negotiations which have taken place with the Ministry of Transport with a view to obtaining Government assistance. He said that the engineers' estimate of the cost of constructing the tunnel was £5,410,000, to which had to be added the estimated cost of lands, properties, &c., amounting to £990,000. There was further to be taken into account the interest on capital during construction, management and supervision, as well as the effect on the revenue of the ferry steamers owing to loss of traffic. These items, together, brought the total sum for which provision must be made up to about £7,250,000, and of that amount the committee had estimated the contributions from the tramways undertakings at £1,500,000. The Ministers who had been consulted expressed themselves unfavourably regarding the imposition of tolls for the use of the tunnel and would not entertain the proposal of a Government grant unless the tunnel was toll-free, which would increase the financial difficulties. Subject to the approval of the Treasury, the Government had, continued Sir Archibald, consented to make a grant towards the construction of the tunnel amounting approximately to £1,750,000, which he himself considered inadequate. On that basis it was estimated that a rate of 5½d. in the pound would have to be raised in the areas of Liverpool, Bootle, Birkenhead and Wallasey. The matter has been deferred in order to give the four corporations concerned an opportunity to consider the details.

Qualifications of Gas Examiners.

A DEPUTATION from the Institute of Chemistry and the Institute of Physics recently waited upon the President of the Board of Trade in connection with the question of the qualifications of the gas examiners appointed by local authorites for the purpose of protecting the interests of public users of gas supplies. In the unavoidable absence of the President (Mr. Sidney Webb), the deputation was received by Mr. A. V. Alexander, Parliamentary Secretary. Sir Richard Gregory stated that the practice of local authorities with regard to the appointment of gas examiners varied considerably. As a general rule the authorities in the metropolitan area and in the larger provincial cities secured for their gas examiners highly competent persons, but small local authorities, particularly in rural areas, regarded with some disfavour expenditure on this kind of service, and the protection to the public from small local gas companies—often not too efficiently directed—was correspondingly reduced. He claimed that the gas examiner should be a person of similar standing to a public analyst, over whose appointment the Ministry of Health could exercise a veto, and he suggested that the Board of Trade should secure this right under statutory powers. Members of the deputation gave examples of the manner in which incompetent gas examiners might fail to detect irregularities. Sir Charles Parsons pointed out that, unlike the case of the measurement of electrical units, no simple instruments existed to help the gas examiner. It was not until he was associated with Sir George Beilby at the Fuel Research Board that he realised personally how difficult the task of carrying out the test with gas calorimeters really was. In summing up, Mr. Marlow, the assistant secretary to the Institute of Chemistry, said that the case of the Institutes was that the word "competence" in the Act required definition, and that the necessary statutory powers should be acquired by the Board to deal with this point. In his reply, Mr. Alexander said that the representations of the deputation would receive the most careful consideration of the Board of Trade, but that in the event of legislation being contemplated the local authorities would have to be consulted.

Waterloo Bridge.

DURING the past few weeks pile driving work has been proceeding at Waterloo Bridge, both downstream of the defective arch, and also on the Westminster side of it, with a view, we understand, to the construction of supporting scaffolding beneath the arch, which will serve until such time as the temporary bridge is ready for use. Further, we learn that the London County Council has placed the contract for the temporary bridge with Sir William Arrol and Co., Limited, Dalmarnock Ironworks, Glasgow. In view of the urgency of the matter, the contract was not submitted to open competition, but will be carried out on a cost and profit percentage basis. The temporary structure will consist principally of timber and steel bracings, and will be built on the Blackfriars side of the existing bridge. It is estimated that the temporary bridge with its new tangent approaches, which will approximate closely to the approaches to the existing bridge, will take about nine months to complete. Traffic will then be diverted from the main bridge, which will be reconstructed and widened to a width of 75ft., as against the existing width of 42ft. 6in. The widening is to be made on the Westminster side.

A New Cross-Channel Boat.

ON Friday last there was launched from the Dumbarton yard of William Denny and Brothers, Limited, the first of two geared turbine twin-screw cross-Channel steamers, which the firm is building for the Southampton–Jersey service of the Southern Railway Company. This new vessel, the Dinard, is 321ft. 6in. long, 41ft. in breadth and 10ft. 6in. deep to the main deck, and she is designed to carry about 1100 first and second-class passengers. The propelling machinery, which is in course of construction in the builder's engine shops, comprises a Parsons single-reduction geared turbine installation, which will work with steam at 180 lb. per square inch pressure. One single and one double-ended oil-fired boiler will be fitted, and they will be arranged for the closed stokehold system of forced draught. The new boat is notable as being the first cross-Channel geared turbine boat to be fitted with oil-burning boilers.

Forced Descents at Sea.

AN interesting test was carried out at Felixstowe by the Air Ministry at the end of last week, when a Napier D.H. 18 machine was used for making a floatation test in order to ascertain how long an ordinary commercial machine of this type would remain afloat if it were compelled to make a forced descent at sea. The machine was flown from Martlesham Heath and planed down into the sea, with the engines shut off, about 11.20 a.m. on Friday morning. The test was carried out a short distance from the experimental air station slipways, and after skimming the water for a few yards, the plane partially toppled over, the fore cabin and part of the fusilage becoming submerged almost at once. The pilot was removed and after a short time the top plane just appeared awash. We learn that the passenger cabin was built of three-ply wood, and that the only alterations made included specially caulked seams and a new type of ventilation fitting for the top of the cabin. The trap door for entering the machine was also made as watertight as possible. It is expected that the data obtained will prove useful in the construction of new passenger aircraft, and will enable steps to be taken to ensure that an ordinary land type of commercial aeroplane can remain afloat at sea for a considerable time without danger to the passengers.

The British Empire Exhibition.

ENGINEERING EXHIBITS, No. III.*

GENERAL ENGINEERING EXHIBITS.

THE NATIONAL GAS ENGINE COMPANY, LIMITED.

The National Gas Engine Company, Limited, of Ashton-under-Lyne, occupies one of the foremost positions among British builders of gas and oil engines. It was founded over forty years ago by Mr. Henry N. Bickerton, and to-day its factories, which are exclusively devoted to internal combustion engine work, are among the largest of their kind in the two hemispheres. Since the beginning of the firm, over 100,000 National gas and oil engines have been installed in various parts of the world, in sizes varying from the smallest up to units developing 2000 brake horse-power.

The lack of space on the Wembley stand only allows a display of engines of comparatively small sizes, but the examples chosen serve to illustrates the chief features of design and the excellency of the material and the workmanship. The most prominent exhibit is the three-cylinder vertical type gas engine, which we show in illustration Fig. 55. It is designed for an output of 150 brake horse-power, when running at a speed of 350 revolutions per minute, and the cylinders are 13in. diameter, with a piston stroke of 14in. This engine is coupled to a direct-current generator built by the English Electric Company, Limited. This type of engine, working on the four-stroke cycle and with completely enclosed reciprocating parts, is representative of a range of vertical engines extending from 100 up to 600 brake horse-power, of which the smaller sizes have single cylinders and the larger sizes tandem cylinders. The main bed-plate is of box-shaped form cast in a single piece with transverse members carrying the main bearing supports. Upon it is mounted the crank case, which is provided with light inspection doors giving access to the bottom ends of the connecting-rods and the cam shaft. The cam shaft is placed about midway between the bed-plate and the top of the crank casing, and is driven by spur gearing from the crank shaft. All the cylinder casings are fitted with loose liners and are bolted direct to the top of the crank case. The crank shaft is turned from a solid forging and is drilled for forced lubrication. Trunk type pistons of the usual pattern are used with a drilled connecting-rod, allowing for the lubrication of the top end bush. The connecting bottom ends are lined with white metal, and compression liners are provided between the palm end of the rod and the bottom end bearing, enabling the compression pressure in the working cylinder to be varied, as desired. Referring to the valves we note that they are of the usual cage type, operated by push rods and levers and placed vertically in the cylinder head, the exhaust valve being provided with a water-cooled casing. Starting is accomplished by means of compressed air admitted to the cylinder through timed starting valves arranged horizontally in the lower part of the cylinder cover. The ignition is in duplicate, the current being furnished by specially designed magnetos driven from the cam shaft. Arrangements are provided so that the timing of the of the ignition may be altered while the engine is running. The governor is placed at the end of the engine and controls two throttle valves in the air and gas inlet pipes respectively. Hand controls are also fitted. From the view given in Fig. 55 it may be noted that the cooling water pipes discharge into open funnels enabling the flow of water and its temperature to be regulated for the most economical use.

The lubrication of the main bearings is effected by means of a pump, which supplies oil under pressure, and a hand pressure pump is employed when starting up. Particular care has been taken to obtain equal turning moment and close speed regulation, so that the engine may be used for driving electric generators. By means of slight modifications, this type of engine may be employed with town or producer gas, or with the less rich gases, such as those obtained from blast-furnaces and coke ovens.

Another interesting engine is that which we illustrate in Fig. 56. It represents the company's latest practice with regard to engines of the National cold-starting crude oil type, which are manufactured in horizontal designs in sizes from 18 to 166 brake horse-power, and in vertical designs from 100 up to 300 brake horse-power. The example we show is one of the horizontal types, which is designed for 35 brake horse-power. It has a 10in. diameter cylinder, with an 18in. stroke, and has been designed to develop its full power when running at a speed of about 250 revolutions per minute. The main frame cylinder crank shaft and connecting-rod are of the robust design we associate with National engines, and the sectional drawing above referred to shows the general arrangement of the air, exhaust, and the fuel valves. It will be seen that the air and exhaust valves are placed vertically in the top and bottom part of the cylinder head, and that the fuel valve occupies a central place in the combustion chamber. Details of the construction of this valve and the arrangement of the fuel pump in relation to it are given by the drawing—Fig. 57. The fuel pump is of the constant stroke type, the amount of fuel delivered to the fuel valve being controlled by the governor, which at light loads by-passes the oil back to the fuel tank. In order that heavy oils may be used an oil heater warmed by the exhaust gases of the engine is fitted, thus effectively reducing the viscosity of the oil.

Illustration Fig. 58 shows a compact form of vertical type of engine which the firm manufactures for agricultural work and country house lighting. Although primarily designed as a gas engine to run from town mains or suction gas supply, it may readily be converted to use paraffin or petrol. The output when burning petrol or alcohol approximates closely to that obtained with town gas, while the suction gas output is similar to that obtained with paraffin as a fuel. The main column and cylinder head are characterised by their simple and clean lines. The engine exhibited has a cylinder 5in. in bore with a piston

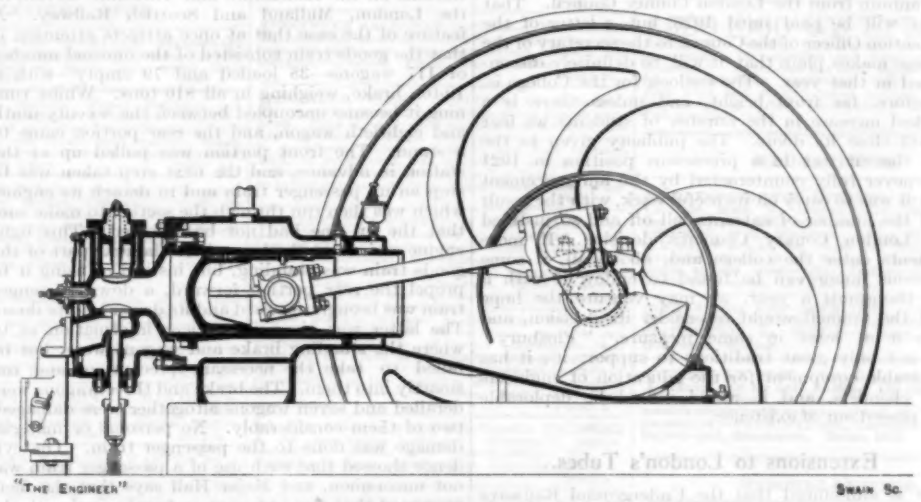


FIG. 56—30 B.H.P. COLD STARTING OIL ENGINE—NATIONAL GAS ENGINE CO.

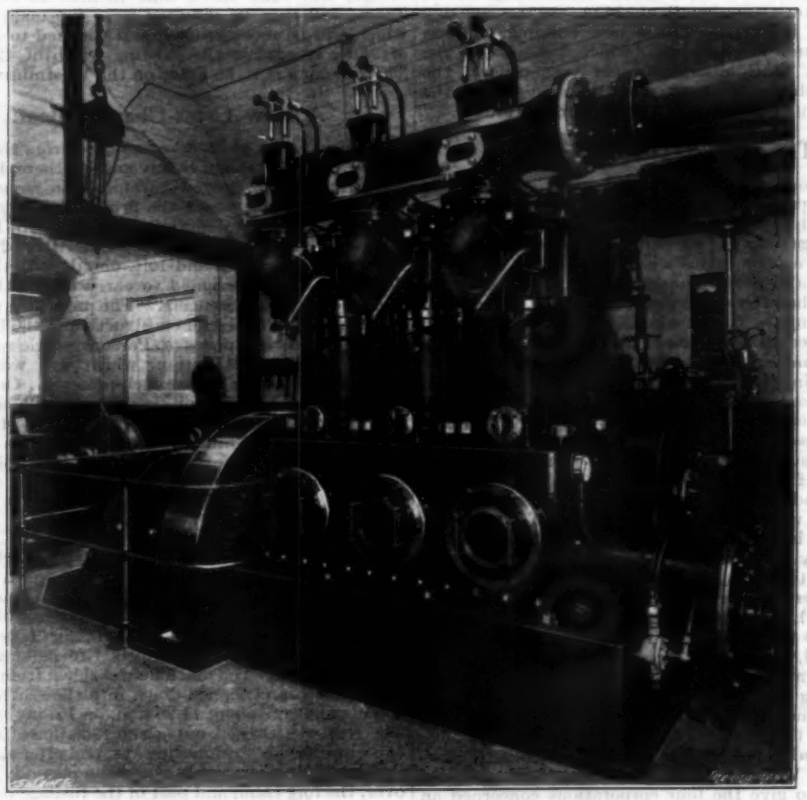


FIG. 55—150 B.H.P. VERTICAL GAS ENGINE—NATIONAL GAS ENGINE CO.

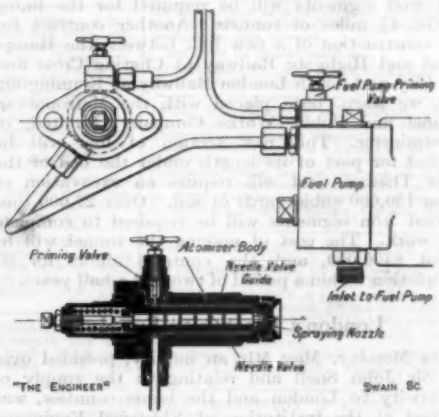


FIG. 57—FUEL VALVE AND PUMP

* No. II. appeared May 2nd.

stroke of 10in., and is designed to develop 6 to 7 horse-power at a speed of from 500 to 600 revolutions per minute. A centrifugal governor driven by a vertical shaft operates a throttle type governing valve, while the ignition current is supplied by a high-tension British magneto. Ease of accessibility is an important factor for engines used for driving agricultural and domestic machinery, and this point has evidently been kept in mind. The set is compact in arrangement, both engine and generator being mounted on a combined bed-plate with one overhung fly-wheel. Another lighting set of neat design is the K E type engine with a 3-kilowatt chain-driven generator. The engine has a cylinder 5in. in diameter by 9in. stroke, and it runs at a speed of 430 revolutions per minute, the dynamo having a speed range of from 1500 to 1900 revolutions per minute. The example shown is one of four sizes varying in output from 1½ to 7½ kilowatts. In this type of engine the main bed-plate is extended to take any of the standard patterns of generators. The drive is transmitted by chain wheels, and an inverted tooth chain of a silent type, this gear being completely enclosed in a light casing. Like the engine we have previously described, either gas or liquid fuel may be utilised. The type is a useful one, since it combines all the advantages of a low-speed engine with the relatively cheap high-speed generator.

Air compressors are generally employed for the starting up of large gas engines, and a typical National direct-coupled gas engine and air compressor is exhibited.

English Electric Company, Limited.

Some hydraulic exhibits of considerable interest are being shown by the English Electric Company.

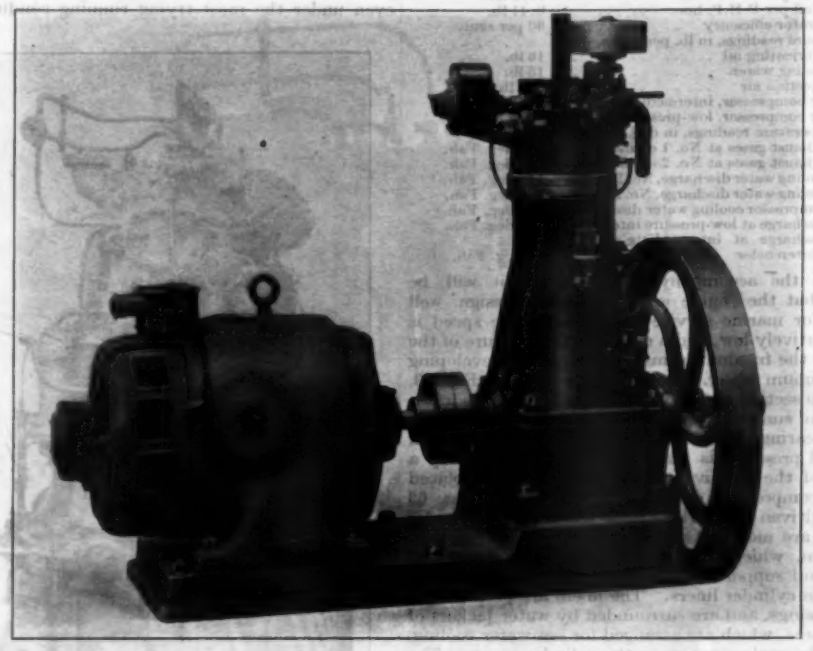


FIG. 58—VERTICAL LIGHTING SET—NATIONAL GAS ENGINE CO.

Amongst them is a wheel for a 30,000 horse-power impulse turbine, of which five are being built for the Behira station of the Tata Company of India. These turbines are to run at 375 revolutions per minute under a head of 1630ft., and will be coupled direct to electrical generators mounted on independent bed-plates. Each set will be fed by two separate pipe lines, fitted with cylindrical balanced valves, controlled by hydraulic servo-motors. By an ingenious arrangement the actual closing of these balanced valves takes place very slowly, so that water-hammer may be avoided. The admission of the pressure water to the servo-motor—drawn from the pipe line—takes place along the thread of a screw attached to the balanced valve, and as towards the end of the stroke a greater length of the thread has to be traversed, the friction checks the supply of water to the servo-motor and makes its action gradually slower. The actual regulation of the jet is effected on the "Seewer" system, in which a blade is first introduced to dissipate the energy of the jet by breaking it up; the spear is then gradually closed. The inlet bend is securely attached to the turbine bed-plate, which is provided with a machined flange for connection with the generator bed-plate. The jet issuing from the nozzle can be exactly centred with the wheel, which is overhung at the end of the generator shaft. A single governor will control the two turbines, and will be situated between them, so as to provide the same amount of regulation at the two bends. The governor will be belt driven, and will be provided with the usual governing devices, adjustment being made by hand or by an electric motor. The oil will be supplied by a two-stage rotary pump, and will be stored in an oil receiver, from which it will be led to one side or the other of a servo-motor, which will control two regulating shafts, designed to transmit movement to the "Seewer" diffuser of the two turbines. The diffusers in their turn will control, by means of distributing valves at the side of the servo-motor cylinder, the spear servo-motor. On its way from the distributing valves to the servo-motor, the oil will flow through regulating screws, similar to those on the control valves.

An overhung bronze runner for a 25,000 horse-power water turbine, built for the Sorocaba power station of the Sao Paulo Power Company, Brazil, is also on view. This turbine—see Figs. 59 and 60—is designed to work under a head of 650ft., and to run at a speed of 600 revolutions per minute. The turbine cover is connected to the main bearings by two strong bolts, thus making the thrust bearing and turbine cover a solid piece. To prevent undue water losses between the runner and turbine casing, only small clearances are permissible, and it is therefore essential that the runner and the shaft, which are centred by the main bearing, should not move relatively to the casing. This renders the provision of the connecting bolts between this bearing and the cover important.

Furthermore, since heat is generated in the alternator, the extension of the shaft might impair satisfactory operation, and the main bearing situated between the generator and the spiral casing has been designed as a thrust bearing. The clearances between the runner and the casing have been made adjustable by the employment of a kind of labyrinth packing between the casing and the lateral faces of the runner. On each side of the runner is mounted a steel ring, on the side of which several fairly deep grooves are turned. Similar rings are attached to the inside of the casing and engage with those on the runner. The sinuous passage prevents excessive leakage of water. The rings on the casing can be adjusted as wear takes place. The runners themselves—see Fig. 61—are made of bronze in order to minimise corrosion.

On the suction bend an air valve is provided to avoid undue suction in the event of a sudden closing of the gate apparatus. In that event, practically no water can pass through the gate apparatus, although there may be still tons of water passing

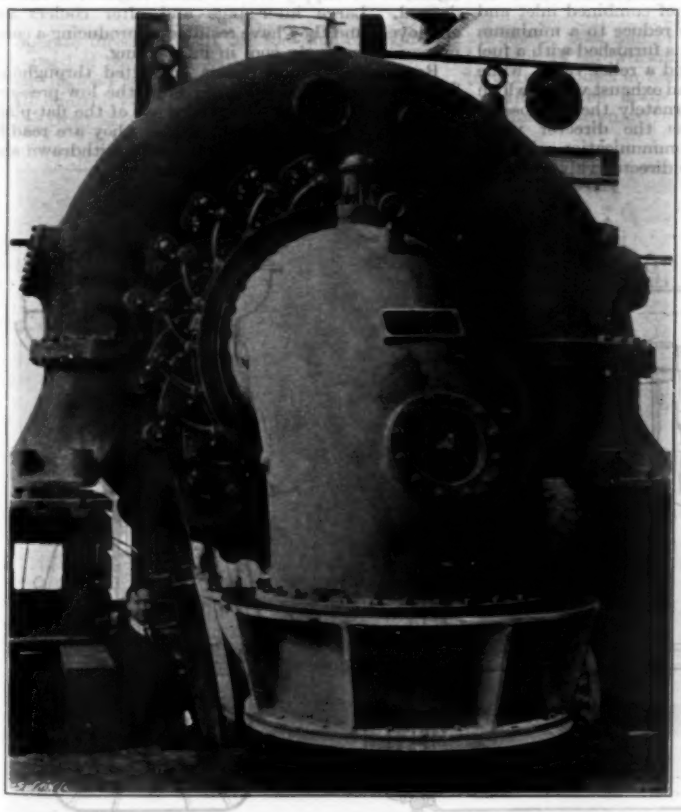


FIG. 59—25,000 H.P. WATER TURBINE—ENGLISH ELECTRIC CO.

FIG. 60—CASING FOR 25,000 H.P. WATER TURBINE

down the draft tube, and, under these circumstances, a vacuum might be produced. The air snifting valve is controlled by the governor, but it can also open itself, rapid closing being prevented by a dashpot. Equalising piping, connecting the space between the runner chamber and the left-hand cover, balances the pressure on both sides of the runner. With the object of securing the same entrance water velocity all round the gate apparatus, the casing has been made in the shape of a logarithmic curve, and in order to face the very high pressure associated with a head of 650ft., it has been made exceptionally strong, and, furthermore, is fastened to an extension of the governor bed-plate, so that the whole thing is one solid construction. Any movement due to the pressure of the water coming from the pipe line is prevented by a special joint in the pipe line, just in front of the sluice valve. The governor is operated by a servo-motor worked with oil under pressure taken from an oil tank. It is of the double compensated type, is very sensitive, and can be adjusted by hand or by an electric motor. An automatic safety drive, which shuts down the set in the event of a speed variation of plus or minus 30 per cent. above or below normal, is also fitted. The oil pressure tank is fed

FIG. 61—RUNNER FOR 25,000 H.P. TURBINE

by an oil pump, which is driven by a small impulse wheel. Between the pump and the tank a special device is fitted, and when the pressure in the tank reaches 16 atmospheres, a valve opens and offers a passage to a tank below, and at the same time the supply to the turbine is reduced. When, on the other hand, the pressure drops to 14 atmospheres, the oil is again made to pass into the pressure tank, and, consequently, the water supply to the turbine is increased.

William Beardmore and Co., Limited, Dalmuir.

A prominent exhibit on the stand of William Beardmore and Co., Limited, is the 120 brake horse-power Beardmore-Tosi generating set, which the firm has specially designed for marine auxiliary purposes.

The engine is arranged as a working exhibit, and it is coupled to an 80-kilowatt 220-volt direct-current generator built by W. H. Allen, Sons and Co., Limited, of Bedford. We reproduce an elevation drawing of the set in Fig. 62, and show in Figs. 63 and 64 other views of the engine. The leading dimensions, with typical full load trial figures, which were taken over a four hours' bench trial run, are given below:—

Brake horse-power	120
Number of cylinders	2
Diameter of cylinders	345 mm. or 13⅝in.
Stroke	480 mm. or 18⅞in.
Nominal speed	250 r.p.m.
Piston speed	785ft. per min.
Generator, amperes	364
Generator, volts	222
Output, in kilowatts	80.81
Fuel oil per K.W.-hour	0.64 lb.
Fuel oil per B.H.P.-hour	0.41 lb.
Generator efficiency	86 per cent.
Pressure readings, in lb. per sq. in.—	
Lubricating oil	16 lb.
Cooling water	15 lb.
Injection air	800 lb.
Air compressor, intermediate stage	190 lb.
Air compressor, low-pressure stage	55 lb.
Temperature readings, in deg. Fah.—	
Exhaust gases at No. 1 cylinder	675 deg. Fah.
Exhaust gases at No. 2 cylinder	680 deg. Fah.
Cooling water discharge, No. 1 cylinder	118 deg. Fah.
Cooling water discharge, No. 2 cylinder	116 deg. Fah.
Compressor cooling water discharge	109 deg. Fah.
Discharge at low-pressure intercooler	109 deg. Fah.
Discharge at intermediate-pressure intercooler	82 deg. Fah.

From the accompanying illustrations it will be noted that the engine is of substantial design, well suited for marine service conditions. The speed is comparatively low, and a characteristic feature of the plant is the freedom from vibration when developing its maximum power. Referring to drawing Fig. 63, the deep section of the main bed-plate, with its lubricating oil sump, may be noted. The crank shaft and main bearings are arranged for forced lubrication, and oil pressure is maintained in the system by a pump of the positive rotary type, which is placed at the compression end of the engine—see Fig. 63—and driven from the crank shaft. The cylinder casings are mounted on a crank case of robust construction, which is provided with large inspection doors and supporting guides for the bottom ends of the main cylinder liners. The liners are pressed into their casings, and are surrounded by water jackets of ample area, which are arranged for sea water cooling, as are the cooling spaces in the cylinder covers. The piston is of the two-part type, and the upper part or cap is supplied with six rings. An item of special interest is the type of piston packing used. It is of a new patented design, and is so arranged that any pressure leakage to the back of the ordinary Ramsbottom rings is prevented, thus avoiding conditions which give rise to excessive wear of piston rings and cylinder liners. The makers inform us that this type of packing has proved very efficient in service, and that when the pistons have been drawn for examination, both the piston and its rings have been found to be in excellent condition.

The cylinder cover embodies the patented features of the Beardmore-Tosi design of combined inlet and exhaust valves, which tend to reduce to a minimum the heat stresses. Each cover is furnished with a fuel valve, an air starting valve and a relief valve, while there are two combined inlet and exhaust valves which operate together, serving alternately the purpose of inlet and exhaust valves, as the director valve places the cylinder space in communication with the air inlet or exhaust pipe. The director valves, which are of special design, are worked by a light excentric gear, driven from the cam shaft. Both the inlet and exhaust valves are furnished with removable valve cages, and all the valves are made so that they may be easily examined and, if necessary, replaced without having to remove the cylinder covers.

Particular reference may be made to the fuel injection valve, which is totally enclosed and has been designed to eliminate packing glands with their attendant troubles. The fuel valve is of the needle type, and opens inwards, and compressed air is used for injecting the fuel.

The three-stage compressor for this purpose is neatly grouped with its intercoolers at the end of the engine, and is driven by a crank which is forged solid with the main engine crank shaft. Particular care has been taken, we are informed, to design the compressor for long service and reliable working, so that even under the most trying running conditions the minimum of trouble may be given. Its capacity has been made sufficiently large, so that, in addition to supplying the necessary fuel injection air, a surplus of air is available for augmenting the starting and injection air supply for the main engines, if this be desired. Large inter-stage and after coolers are employed, and they have resulted in producing a compressor exceedingly cool in its working.

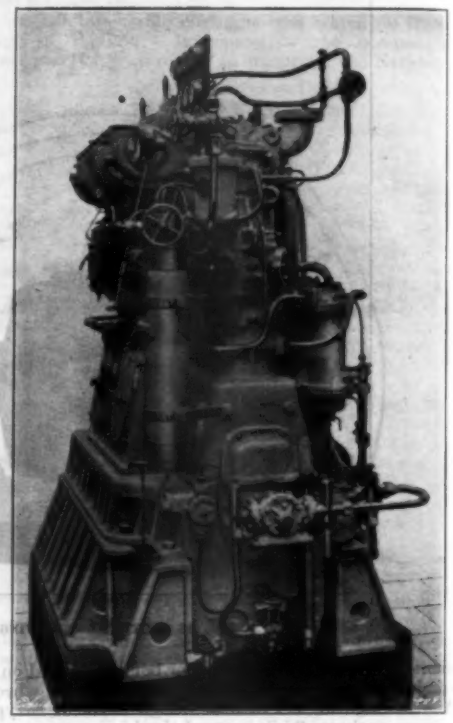


FIG. 63—END VIEW OF ENGINE

Renewable cylinder liners are fitted throughout. The air compressor valves in both the low-pressure and intermediate-pressure stages are of the flat-plate type, and they are so grouped that they are readily accessible for examination and can be withdrawn and replaced again in a few minutes.

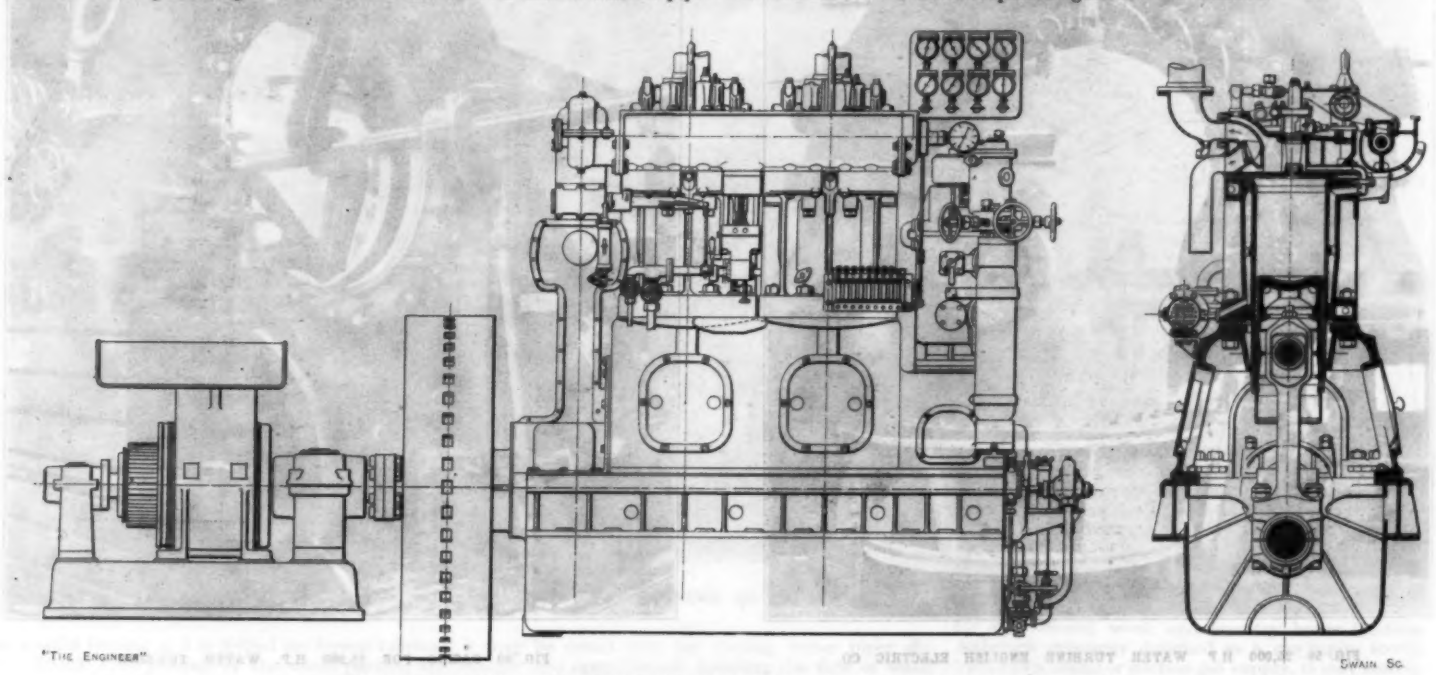


FIG. 62—ELEVATION AND CROSS-SECTION OF BEARDMORE-TOSI AUXILIARY LIGHTING SET

We noted with interest that for starting the engine air at the unusually low pressure of 350 lb. per square inch was employed. The advantage of this procedure is that it permits common air receivers to be used for starting the main and also the auxiliary engines of a marine installation.

On trials which have been made we are informed

that the engine was started with perfect ease, with air at a pressure of 150 lb. per square inch. The builders consider this a most desirable feature, for it makes for much easier starting conditions in the engine cylinder, as the extreme cooling effect of high-pressure starting air is entirely done away with. Mention may be made of the centrifugal governor, which is neatly enclosed in the vertical shaft casing, and arranged

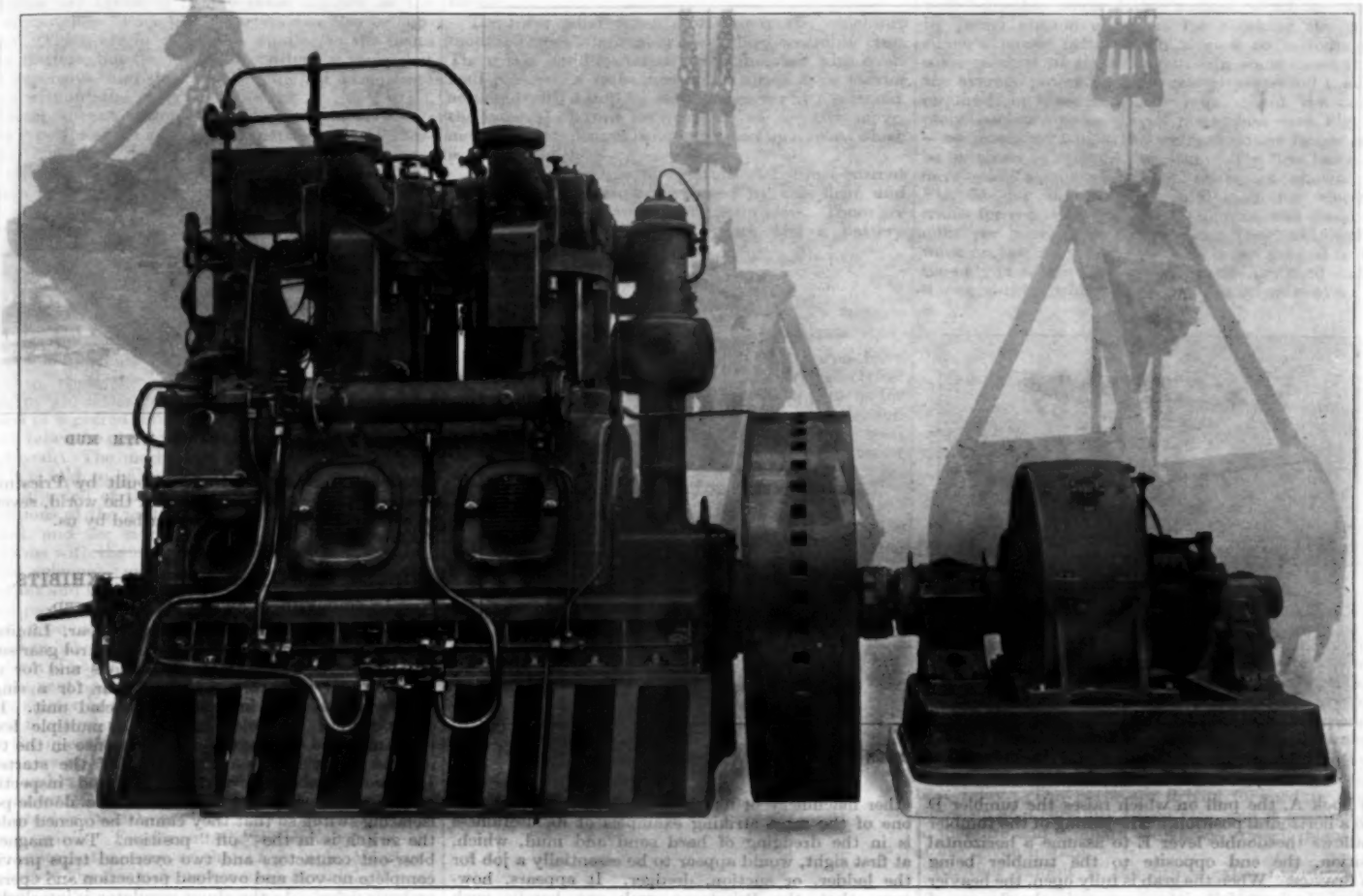


FIG. 64—120 B.H.P. BEARDMORE-TOSI SHIP'S ELECTRIC GENERATING PLANT

to operate directly on to the fuel pump, regulating the speed of the engine within very fine limits, even when the load is suddenly put on or thrown off.

All control valves and levers are neatly grouped at the front side of the engine near the starting platform, and a gauge board is also fitted, showing the air, lubricating oil and water pressures. When installed in the ship, a proper starting platform, similar to that used at the Exhibition, is employed, and the engine may be started, stopped and controlled from this platform. The type of auxiliary we have described has already given excellent service in the Beardmore motor ships Pinzon and Pizzaro, and several other sets of machinery of the same type are, we learn, now under construction.

PRIESTMAN BROTHERS, LIMITED.

The dredging equipment manufactured by Priestman Brothers, Limited, of Hull, is represented by a large model which shows a variety of grab hopper dredgers, coal and ore handling plants, and similar machinery in working conditions, while there are working models in brass of several Priestman grabs.

Among the grabs, those illustrated by Figs. 65, 66 and 67 are most noteworthy, and the two types

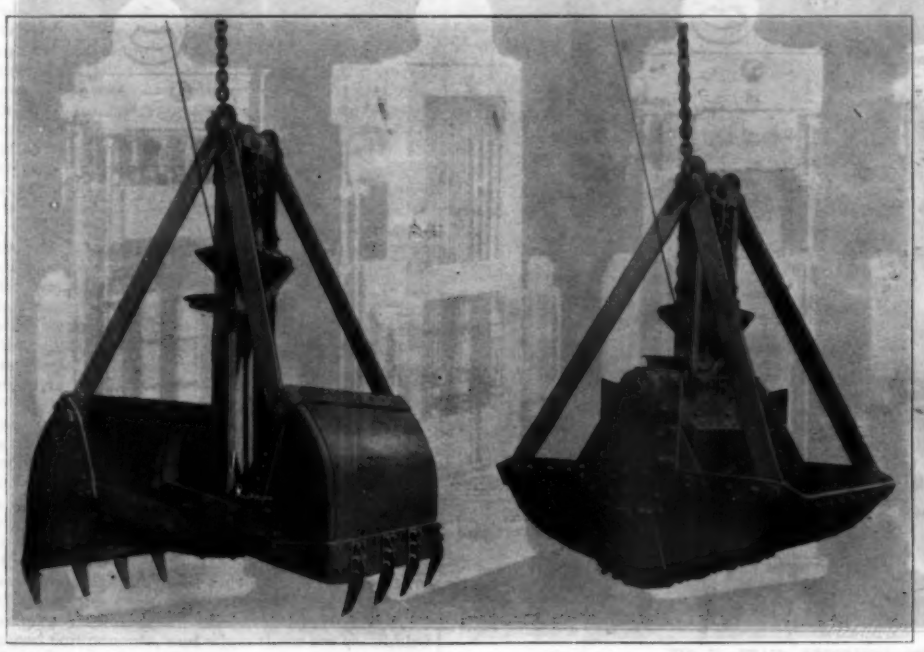


FIG. 65—PRIESTMAN DUMPING GRAB

are intended for different working conditions. That represented in Fig. 65 is for use in connection with an ordinary single fall crane, and is hooked on to the chain just in the same way as a skip or bucket. It will be noticed that there is a four-part purchase between the head of the grab and the crosshead, which is connected with the centre girder of the grab through the intervention of an oil dashpot. In operation the grab is lowered on to the material to be handled in the open position, and the chain then paid out until a locking gear engages with the centre girder. On hoisting up again the jaws are closed together and the grab filled. When the grab has been swung to the discharging point it can be unloaded there by pulling the cord, which can be seen in Fig. 65. This cord is connected with the trip gear, and can be operated regardless of the height to which the grab is hoisted. The load may also be dumped by lowering the grab on to the ground. The lever of the trip gear is arranged at right angles to the direction of the opening of the grab, so that if the attendant has to stand close at hand he is

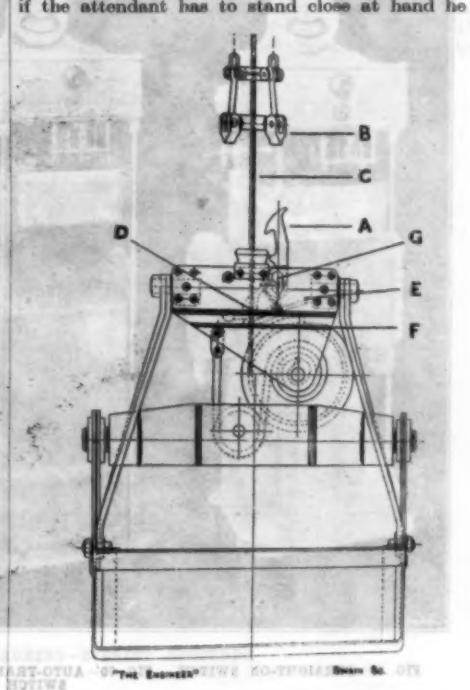


FIG. 66—GRAB CONTROLLING GEAR

not likely to be struck by the opening jaws or the falling load. The shock of dumping is absorbed by the dashpot.

The second form of grab—illustrated by Figs. 66 and 67—is also of the single-rope type, and is intended for dumping at a fixed height, the height

being determined by the position of a ring hung round the hoisting rope from the jib head. The operation of the grab can be followed best with the aid of Fig. 66.

The loaded grab is hoisted until the hook A engages with the discharging ring B. The hoisting rope C is then paid out, allowing the jaws to open, at the same time transferring the weight of the grab to the hook A, the pull on which raises the tumbler D into a horizontal position. The raising of the tumbler D allows the double lever E to assume a horizontal position, the end opposite to the tumbler being the heavier. When the grab is fully open, the heavier end of the lever falls into a recess in the flanges of the barrel F. On tightening the hoisting rope the barrel F locks the lever E in the horizontal position, thus maintaining the tumbler D in the raised position. When the grab is slightly lifted the hook A pivots about the pin G and falls outward clear of the discharging ring B. The grab can then be lowered for a fresh load. As soon as the grab rests upon the material to be lifted, the hoisting rope is slackened, thus removing the load from the lever E and allowing the tumbler D to fall, which in turn causes the lever E to be lifted from engagement with the barrel F. The barrel F is then free to revolve and the grab can be closed in the material by winding up the hoisting rope. The hook A is now in the vertical position ready for re-engagement with the discharging ring B when the grab is again lifted to discharge.

The great merit of the grab dredger, as compared with other types, is that it is versatile in its applications, and can often be used in conditions where no other machinery of its class could be employed, but one of the most striking examples of its usefulness is in the dredging of hard sand and mud, which, at first sight, would appear to be essentially a job for the ladder, or suction, dredger. It appears, however, that the Priestman grab can handle such material very satisfactorily on account of the squeezing action of the jaws, as they dig into the bottom, driving out the contained water, so that the grab is filled with practically solid material. The result is that a minimum of water is brought up with the spoil, and when the grab is dumped over the hopper there is much less liability for the fine stuff to be washed overboard again, than is the case with dredgers which raise a large proportion of water with the spoil. The extent of this solidifying action on the material dredged is plainly illustrated by Fig. 68, which shows a load of mud raised from the bottom of a dock.

Besides the models of the grabs described, there are, on this stand, several others representing typical examples of complete dredgers built by Priestman Brothers for service in all parts of the world, several of which have already been described by us.

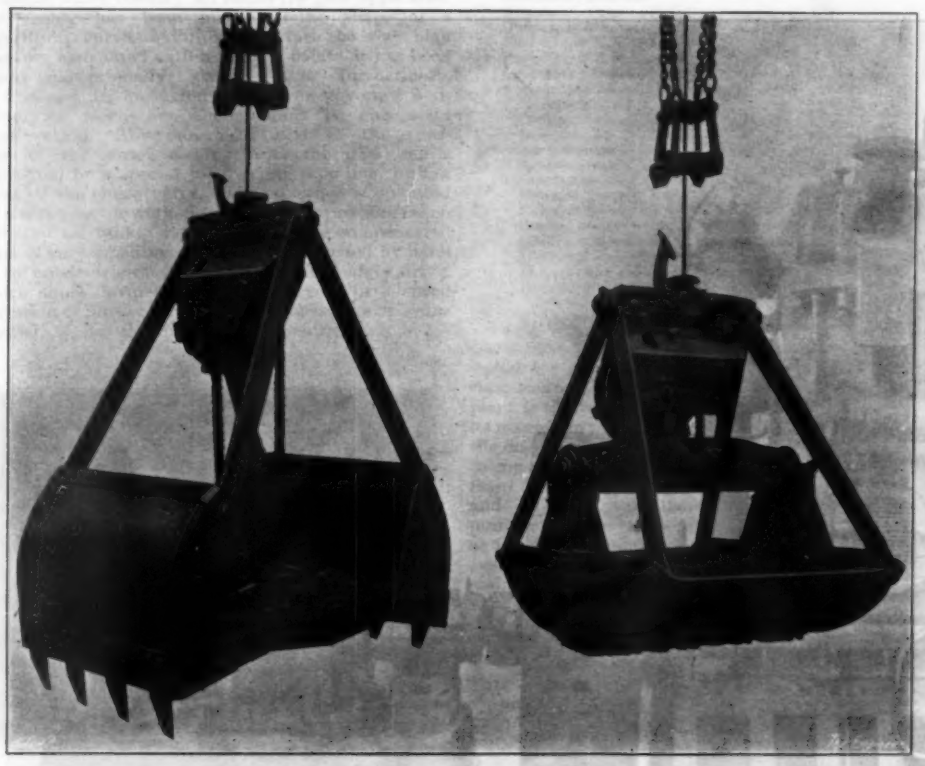


FIG. 67—PRIESTMAN SINGLE-ROPE GRAB

FIG. 68—GRAB LOADED WITH MUD

ELECTRICAL ENGINEERING EXHIBITS.

BROOKHIRST SWITCHGEAR, LIMITED.

The exhibits of Brookhirst Switchgear, Limited, of Chester, consist of electric motor control gear suitable for normal industrial applications and for use by unskilled operators. All the gear for a single motor is contained in a single ironclad unit. For direct-current operation drum and multiple lever type units are shown, the only difference in the two designs being in the construction of the starters. Ironclad panels are used with glazed inspection doors, which are interlocked with the double-pole isolating switch so that they cannot be opened unless the switch is in the "off" position. Two magnetic blow-out contactors and two overload trips provide complete no-volt and overload protection and operate on both poles. As the shunt regulator is interlocked with the contactors, it is impossible to start up the motor with a weak field. Under all conditions the armature circuit is broken on the contactors. The drum and multiple lever type of starter are both designed to minimise arcing at the contacts. Hurried or incorrect starting is impossible, and it is also impossible for the operator to leave the starter in an intermediate position. At the same time all the units are designed so that there is no difficulty in "inching" the motor. The drum type starter used for the small and medium sizes of hand-operated

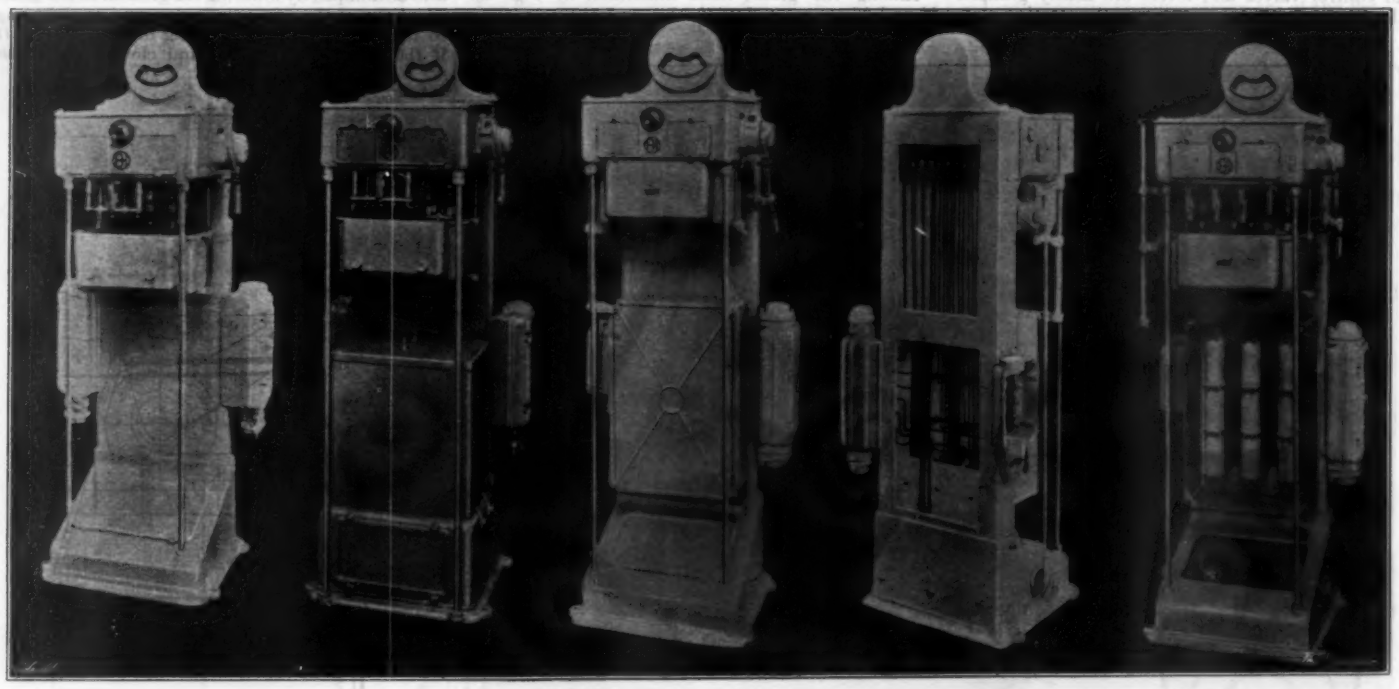


FIG. 69—STRAIGHT-ON SWITCH FIG. 70—AUTO-TRANSFORMER SWITCH FIGS. 71 AND 72—FRONT AND BACK OF ROTOR SWITCH FIG. 73—FRONT COVER REMOVED

switches are fitted with the Brookhirst slow-motion ratchet handle mechanism, which ensures that the starting operations are carried out in the proper sequence, and if the starting operation is for any reason interrupted the drum must be returned to the "off" position.

Larger hand-operated switch panels have multiple lever starters, consisting of a series of lever switches for cutting out the starting resistance, but these switches are operated in the same manner as the other switches. Face plate starters can also be supplied. These are in every way similar to the drum type starters, but the face plate pattern is somewhat less expensive, and they can be supplied as separate units without the other components.

Direct-current automatic equipments of the solenoid type for small and medium capacities and automatic contactor type switches for large capacities are also on view. Apart from the starters, the solenoid panels are similar to the hand-operated panels and are provided with all the safety devices which we have mentioned. These automatic panels, however, have a starter of the solenoid type, and they are not of the sliding contact or multiple contactor type. An ingenious movement combines the simplicity of the former design with the instantaneous face contact on each step provided by the latter design. A spiral spring ensures an efficient contact pressure on each step and prevents the possibility of the starter sticking when the solenoid is de-energised. The speed at which the starter is operated is controlled by means of a geared retarder of the eddy current type, which takes the place of the air dashpot that is usually employed. The mechanism is exceedingly reliable, and it is said, to be unaffected by climatic conditions. It is adjusted at the outset for the normal starting conditions of the particular motor that is to be controlled, and the starting speed then automatically conforms with the motor acceleration.

The solenoid type panels are supplied both for constant and variable-speed motors, and the variable-speed panel is made in three types. The hand-regulated type has a separate hand-operated shunt regulator, which may be mounted near the operator, this form of panel being designed for conditions involving frequent speed regulation. The automatic regulating starter has a solenoid operated shunt regulator which is operated by a push button which is placed near the operator. It gives automatic regulation up to any set speed and gives complete control of the speed and is suitable for frequent starting and speed adjustment. The contactor type panels have a series of contactors which are controlled by a solenoid master switch. Fundamentally the arrangement of these units is the same as that of the solenoid type panels, but the design is rather more flexible. When desired, motor protective devices and safeguards for the operator can be fitted and various forms of speed regulation can be arranged for.

Hand-operated alternating-current oil-immersed control units of the multi-switch type are made in four forms—known as "Straight-on," star-delta, auto-transformer, and rotor units, shown in Figs. 69 to 73. As in the case of the direct-current control units, a single ironclad unit serves for the control of one motor, and the units comprise in each case a starter and a circuit breaker. The units are of the multi-switch type, and the switches are operated by a single ratchet handle, which first closes the circuit breaker and then the starting switches in the correct sequence and with a step-by-step action. The components are practically identical for widely varying currents and pressures and also in the three forms of starters. There is no spring return, but once the starting operation has been commenced it must be completed, otherwise the circuit breaker is tripped, and it can only be re-set when the starting handle has been returned to the "off" position. The circuit breaker is provided with no-volt and overload trips which are free to operate at any time during the starting or running periods.

The pillar type units are made with and without isolating switches, which are of the air break type, but the oil-immersed circuit breaker is always tripped before the isolator opens. The pillar type units with isolators are also provided, with cover interlocks which prevent the possibility of operators coming into contact with live parts. The provision on the star delta and auto-transformer starters of an overload restrainer prevents the overload trips from operating during the starting period except when the currents are excessive or when there is a short circuit; but after the starting operation has been completed the restraint is automatically removed and the trips are free to act under normal excess currents. Except in cases in which heavy peak currents have to be provided for during running time, lags are unnecessary. Oil-immersed switchgear consists essentially of self-contained components, and when these are assembled in pillars the question of interconnection is of considerable importance. The Brookhirst assembly case provides proper accommodation for the interconnections, which, owing to the removable back doors, are easily inspected, as shown in Fig. 72.

For alternating-current automatic operation a range of control gears has been designed on similar lines to those described. The star-delta type of starter consists of two units mounted upon a patented hollow assembly case. The first unit consists of a hand-operated circuit breaker with overload releases and a patented restrainer, whilst the second unit consists of two contactor switches, one for starting and the other for running. The first switch is operated by a push button, whilst after a proper interval the second switch is operated by a relay. After the running contactor has closed, the patented restrainer is re-adjusted for the running position by a solenoid. The auto-transformer starting pillar is similar to the star delta unit, but it is, of course, provided with a transformer.

The rotor pillar consists of three units, which are mounted upon the maker's standard assembly case. There is a hand-operated circuit breaker with overload releases, a resistance and a drum type starter actuated with a step-by-step movement by a solenoid, the interval of time between the consecutive movements of the solenoid being governed by a relay which is adjustable.

A range of midget alternating and direct-current control gear has been developed by this firm, and examples of this form of gear are on view. There are also special service control gears and a battery charging panel.

ELECTRICAL INSTRUMENTS.

EVERETT EDGCUMBE AND CO., LIMITED.

Everett Edgcumbe and Co., Limited, who have specialised in the manufacture of industrial electrical measuring instruments and controlling apparatus for the last half century, are showing a good collection of their products. Protective relays are to be seen in actual operation on a miniature transmission

FIG. 74—CURRENT TRANSFORMER—EVERETT EDGCUMBE

system. The company's "superscale" instruments, which are now extensively used, are shown; also a very convenient portable alternating-current testing set which consists of two instruments side by side, one being a wattmeter and the other a combined ammeter and voltmeter of the universal moving-iron pattern. To obtain a current or voltage measurement, it is simply necessary to press a knob, which disconnects the instrument winding from the voltmeter terminals and connects it to the secondary of a small current transformer, through the primary of which the current to be measured passes. The makers' standard set has volt and watt ranges of 150, 300 and 600, and a current range up to 6 ampères. By the use of instrument transformers, however, these ranges can be extended to any desired extent. The "Omni-range" current transformer shown in Fig. 74 is very useful for this purpose, for it is provided with primary windings for 5, 20 and 100 ampères, and it has a central hole, as shown, through which a conductor can be threaded any desired number of times, thus providing ranges of 250, 500, 1000 and 2000 ampères.

The Everett Edgcumbe "Inkwell" recording instruments are too well known to need description, but reference may be made to the company's "Inkwell" graphic power factor meters, which are used by power station engineers for checking the consumer's power factor, with a view to introducing some method of improving it. In some cases it is the average power factor over a given period that is required, and to meet this requirement the company has developed a special planimeter—see Fig. 76—by means of which the average power factor can be obtained by a single operation. The firm has also developed a recording apparatus—as shown in Fig. 75—for use on tube and main-line electric trains for recording the volts, ampères, and speed in miles per hour throughout a run. The "graphers" work on the relay principle, which has proved to be the only principle that can be successfully used under the conditions which are met with on railways. A

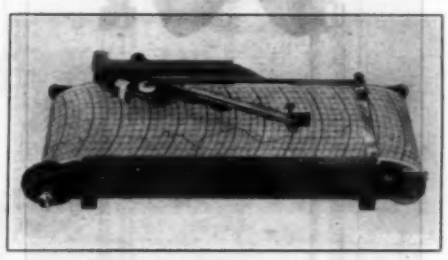


FIG. 76—POWER FACTOR PLANIMETER

small motor runs at constant speed, irrespective of the voltage, and it performs two distinct functions. It drives the actuating parts in synchronism with one another, and it also provides the power necessary for moving the recording pens across the chart in response to the electrical movements, which indicate the value of the quantities which are to be measured, the motion being transmitted over a sensitive and perfectly dead-beat relay. The parts are driven forward in synchronism at a carefully timed rate, and it is possible to measure and compare the values of each quantity at any given instant.

Another exhibit is the firm's extra high-tension electrostatic voltmeter—shown in Fig. 77—which is designed to read up to 300 kilovolts. The readings are unaffected by frequency, and are quite accurate, irrespective of whether one pole of the system is earthed or not. These voltmeters, we are told, are being largely used by cable makers, both in the factory and also for the final tests on site. A small electrostatic voltmeter reading up to 3000 volts and with a dial 3½in. in diameter, is also shown, this being, it is said, the smallest instrument of the kind that has been produced. The development of radio work has given rise to entirely new problems in connection with the measurement of current and voltage at frequencies

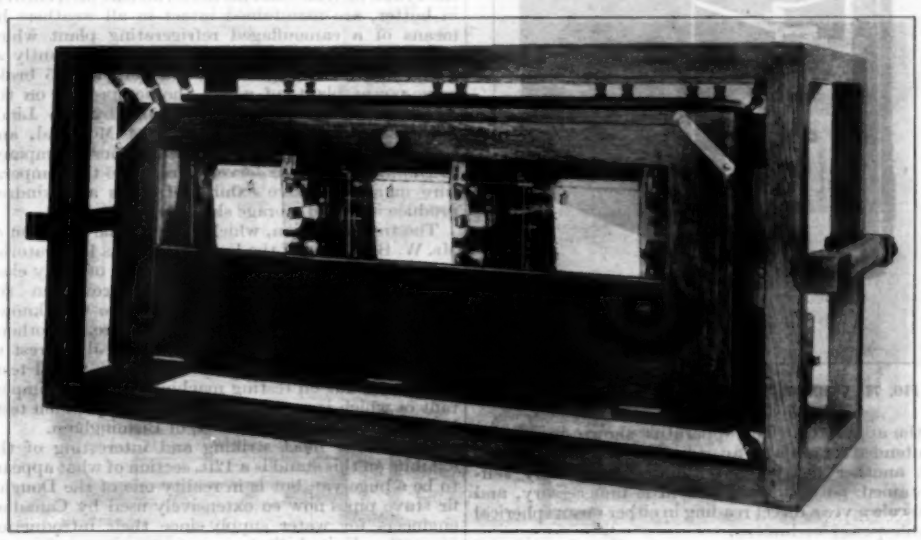


FIG. 75—TRAIN RECORDING INSTRUMENT—EVERETT EDGCUMBE

up to 1,000,000 cycles per second, and for pressures up to 300 kilovolts at radio frequencies these high-tension electrostatic voltmeters have been modified so as to eliminate the difficulties associated with dielectrics, which, unless special precautions are taken, are liable to be destroyed in a very short space of time.

The advent of gas-filled electric lamps and the general extension of illuminating engineering, have

necessitated the use of new arrangements in connection with the photometric measurement of candle-power. The mean horizontal candle-power which was at one time almost universally adopted, is now recognised to have little meaning, and the mean spherical candle-power or the average candle-power in all directions, which corresponds to the total output of light, is now required. The conception of "luminous" flux radiating in all directions is what illuminating engineers are now concerned with, and the luminous output of a lamp is expressed in lumens or mean spherical candle-power, which is roughly equivalent to 12 lumens. For the direct measurement of spherical

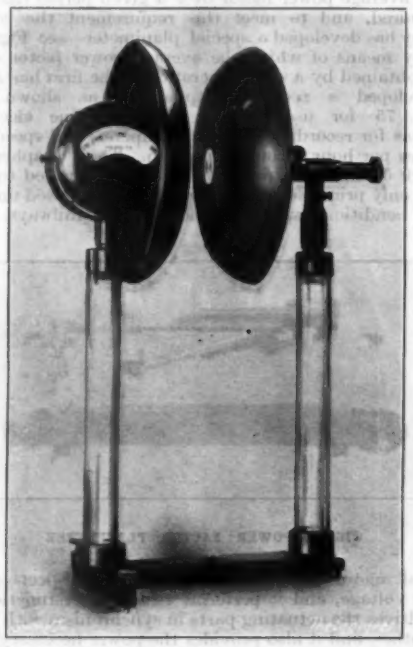


FIG. 77—ELECTROSTATIC VOLTMETER—EVERETT EDGCUMBE

candle-power, Everett Edgcumbe and Co., Limited, have produced the cube photometer—shown in Fig. 78. The instrument constitutes a practical development of the principle that a lamp enclosed in a suitably dimensioned rectangular chamber provided with a highly diffusing inner surface will illuminate the whole of the surface equally and to an extent proportional to the output of the lamp.

By measuring the brightness of a selected part of the surface with a photometer, the mean spherical candle-power of the lumens emitted by the lamp can be determined. Although the basic principle is extremely simple, innumerable precautions and refinements were found to be necessary in the design

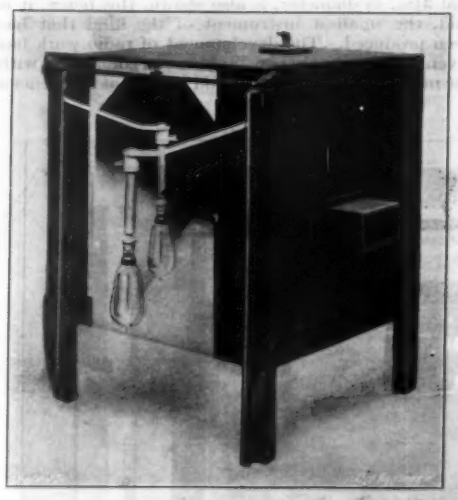


FIG. 78—CUBE PHOTOMETER—EVERETT EDGCUMBE

of the apparatus. The apparatus shown in Fig. 78 is intended for use with an ordinary photometer bench, but another instrument exhibited is entirely self-contained, so that a dark-room is unnecessary, and the scale gives a direct reading in either mean spherical candle-power or lumens.

THE CANADIAN SECTION.

A Preliminary Survey.

As one enters the main Canada Building, from no matter what part of the British Empire Exhibition, one experiences a strong impression of relief and repose. There is a quiet artistic dignity about the design, the decorations and the whole atmosphere which is totally lacking in many other buildings, and is not attained to the same degree in any one of them. There is a sense of order and efficiency and of completeness which is refreshing, and the secret of it all is that Canada has taken this vast show very seriously and that every man on the Canadian Commission, from Mr. A. W. Tolmie, the Commissioner, downwards, is used to the organisation and handling of exhibitions which have to do with Canadian propaganda. It has become such a habit to speak of the vastness of the Exhibition at Wembley Park that it will come as a surprise to many that Canada holds every year at Toronto an exhibition, the Canadian National Exhibition, covering an area which is much larger than that of the British Empire Exhibition, and enjoying an average daily attendance of visitors of about 150,000. Furthermore, the Canadian Government has a standing Commission for the conduct of Canadian exhibits in the United States and all over the world.

The Canadian section at Wembley is contained in three large buildings standing in alignment, of which the main building, approximately 400ft. by 200ft., is divided longitudinally into two sections, as shown by the plan which we reproduce. These two sections are devoted to resources and industries respectively, the former being purely a Government undertaking and the latter containing the exhibits of individual firms.

Although the Government section, which is the larger of the two, is possibly primarily intended to attract the potential immigrant, it contains a mass of matter which is of direct and practical interest to the engineer. It is divided into three main groups; mining and geology, at one end of the building; agriculture and farm produce, at the other; and timber, occupying most of one of the sides of the building between the two others. The two outside pavilions which flank the main building contain the exhibits of the Canadian Pacific Railway and of the Canadian National Railways respectively.

We deal first with the main building and the Government wing of it. The mining and geological section, which is under the direction of Mr. W. D. Dalgleish, the Government Mineralogist, contains specimens of every sort of ore which is worked in Canada, including a gigantic solid silver nugget weighing just under 2 tons. It is the largest in the world and came from the Keeley Mine in South Lorrain, Ontario. Among the specimens shown are gold quartz of many grades and alluvial deposits, silver, copper, iron and lead ores, coal, rock salt, mica, marble, talc, asbestos, magnesite, antimony, corundum and sulphur, besides petroleum and a vast collection of concentrates, by-products, smelting products and articles manufactured from some of them. Each specimen is laid out within easy sight of the visitor and carefully marked. This section occupies an area of about 9000 sq.ft., and in it is the material for a week's mental food for the geological visitor. Further geological specimens are to be found in the show cases down the centre of the building.

Adjoining the geological section are two elaborate panoramic models illustrating mining and smelting, and four other equally effective panoramic models, all with mechanical moving parts, of which the two of most practical interest to engineers are those representing typical railways and agricultural scenes.

Equally elaborate and well laid out, though of less direct interest to the engineer, is the agricultural and farming products section. It is, however, interesting to note that the colossal model of a dairy farm with a landscape and a three-quarter life size statue of the Prince of Wales and his horse, all executed entirely in butter, are maintained intact in all weathers by means of a camouflaged refrigerating plant which keeps the temperature inside the case constantly at 2 deg. above freezing. This is a compact 15 brake horse-power plant, of which the compressor on the direct expansion system was built by the Linde Canadian Refrigerator Company, of Montreal, and the motor by the Canadian Westinghouse Company, of Hamilton. It also serves to regulate the temperature in an extensive exhibit of hams and kindred produce in a cold storage show case.

The timber section, which is under the direction of Mr. W. B. Stokes, of the Forest Products Laboratories of the Government, contains specimens of every class of commercially valuable timber grown in the Dominion. Many of these timbers are well known throughout a great portion of the Empire, but others, equally valuable or of merely academical interest to countries outside Canada, are there. Practical tests are carried out on testing machines, the most important of which is one for tensile and compression tests by W. and T. Avery, Limited, of Birmingham.

One of the most striking and interesting of the exhibits on this stand is a 12ft. section of what appears to be a huge vat, but is in reality one of the Douglas fir stave pipes now so extensively used by Canadian engineers for water supply since their introduction from the United States some twenty years ago. Several specimens of the smaller pipes are also shown. The wooden pipes in use vary from quite small sections up to 14ft. in diameter and all are built up of staves on the cask principle. The smaller pipes are made in definite lengths, jointed in the usual manner. The large pipes, however, are built up, on their site, of staves of any odd lengths, but of equal widths, each individual stave being butt jointed to its predecessor, and the ends being grooved to receive a steel tongue, Such pipes therefore are endless, *i.e.*, without joints, in the ordinary sense of the word. Photographs of pipe lines in operation demonstrate that such pipes are sufficiently flexible in themselves to negotiate any curves that occur in ordinary practice. The larger pipes are bound with a series of steel bands and the smaller sizes are wire wound. In practice it is found that, if properly constructed and if no sap wood is used, the pipes are virtually imperishable, the metal bindings alone being subject to decay by corrosion. This corrosion, however, is obviated by a process of overlaying or "burlapping" with spiral bands which have been treated with a solution of tar and asphaltum.

The Industrial Section, which is under the direction of Mr. J. S. McKinnon, may truly be described as a triumph of compressed display. Here the stands, although they number but little over one hundred, contain the exhibits of over four hundred firms, which between them cover practically the whole range of Canadian manufactures. In other words, in about one-fifth of the space we have just about as many individual firms showing their goods as there are in the whole of the General Engineering Section of the Palace of Engineering. This condensation has been effected by carrying out, to a very much greater extent than elsewhere, the principle of collective exhibiting, which has been tried successfully in other parts of the Exhibition. A very large number of these collective exhibits have to do with the engineering industry, although, numerically speaking, the percentage of machines shown is not as large as might have been wished. They have the great advantage, from the point of view of the investigator, of producing a very good all-round representative collection of a nation's products without re-duplication and redundancy.

The Steel Company of Canada, Limited, of Hamilton, Ontario, has an extensive exhibit of pig iron, billets, wire rods, steel and iron bars, sheet metal, railway track material, wood and machine screws, bolts, nuts, rivets, black and galvanised pipes, couplings, nails, lead pipes, drop forgings, fencing, shot, putty, white lead, sulphate of ammonia and benzol. The British Empire Steel Corporation, of Montreal, exhibits iron ore, pig iron, silica and fire-clay bricks and by-products, coal, limestone, dolomite, rails, steel bars and sections, shafting and wires of many sorts. The Canada Creosoting Company, of Toronto, and the Dominion Tar and Chemical Company, of Montreal, exhibit a number of samples of creosoted railway sleepers, telegraph, telephone and fencing posts. The Canadian Ingersoll-Rand Company, of Montreal, has a compact stand with a representative show of stationary and portable air compressors, rock drills, pneumatic paving breakers, chippers, caulkers, riveters, and sand rammers. The company is also showing hoists and direct-acting and centrifugal pumps. The Dodge Manufacturing Company, of Toronto, displays shafting and other transmission equipment, split wooden pulleys, and elevator and conveyor parts. There are three good exhibits of brass goods, viz., by the Empire Brass Company, of London, Ontario; the Galt Brass Company, of Galt, Ontario; and Jenkins Bros., of Montreal. They comprise valves, cocks and other steam fittings in considerable variety, and vitriol tanks.

In spite of the importance of the machine tool and woodworking machinery industries in Canada, there is a very inadequate show of these things, though, as far as they go, their quality is high. The few machine tools shown are made by Messrs. McDougall and Co., of Galt. They are grouped on one stand with woodworking machinery which is constructed by two firms, viz., the Cowan Company, of Galt, and the Canadian Machinery Corporation. Among the woodworking machines are a hollow chisel morticing machine, a combined woodworker, an automatic straight-edging saw bench and fans for the collection of wood refuse in saw mills; whilst the Shirly-Dietrich Company, of Galt, makes a good display of circular and other saw blades and kindred tools.

Another important engineering industry in which we are disappointed is agricultural machinery. Apart from the mechanical panoramic models in the Government Section, already referred to, the industry is only represented pictorially and there is only one exhibitor, the International Harvester Company, of Hamilton. The Taylor-Forbes Company, however, is showing lawn mowers of a new type.

Concrete machinery is shown by Messrs. Wettlaufer Bros., of Toronto, whose exhibit includes a mixer, a hoist, and brick and tile moulding and pressing machines. The Canadian Linderman Company, of Woodstock, Ontario, is also showing mixers and other contractors' plant. Messrs. Caron Bros., of Montreal, and the Delco Light Company, of Toronto, are showing light, water and power plants, the former having also an interesting wireless equipment and a collection of metal stampings.

Vacuum cleaners have been seen in such quantities at so many exhibitions lately that one gets a little tired of them. Here, however, is one by the Hoover Suction Sweeper Company, of Hamilton, which is worth seeing. It is provided with an ingenious beating, or tapping, attachment which taps the material gently while the suction is applied, thus giving every particle of dust an opportunity of detaching itself whatever its position may be. The Ker and Goodwin Machinery Company, of Brantford, Ontario, exhibits three oil engines, and there are a few other types of internal combustion engines in this section.

Unquestionably the motor vehicle industry is the

best represented of the Canadian mechanical industries. Several firms are showing vehicles, of which the Ford Motor Company, of Canada, whose works are at Hamilton, exhibits a considerable number, we believe, fourteen. Only two can be shown simultaneously on account of the limitations of the stand.

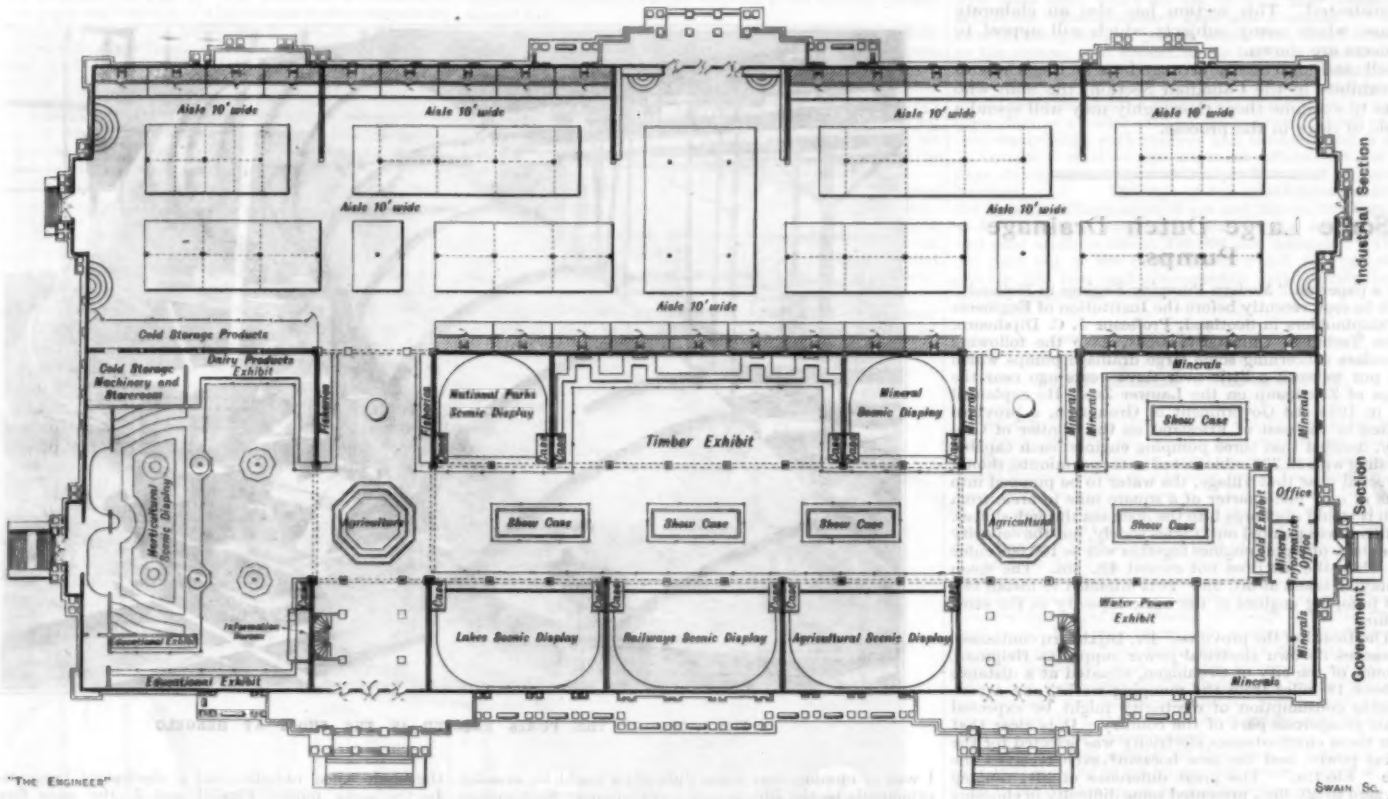


FIG. 79—PLAN OF THE MAIN CANADIAN BUILDING

The others are kept close by and those on the stand are changed from time to time. A very complete range of the standard Ford exchange parts is displayed on the walls of this stand. The General Motors of Canada, of Ottawa, Ontario, exhibits four very handsome touring cars, viz., one each of the "Buick," "Oakland," and "Oldmobile" types, which are all of the six-cylinder five-seater class, and a "Chevrolet" four-cylinder five-seater. The Willys-Overland Company, of Toronto, shows a Willys-Knight car. The Gotfredson Truck Corporation, of Walkerville, Ontario, is showing a 40–50 cwt. chassis for commercial cars and 'buses of from 1 to 6 tons. Four firms, the Goodyear Tire and Rubber Company, the Gutta Percha and Rubber Company, and the K. and S. Tire and Rubber Goods Company, all of Toronto, and the Firestone Tire and Rubber Company, of Hamilton, are exhibiting a big selection of motor vehicle tires, inner tubes, &c.

One of the most striking exhibits in connection with the motor industry is that of the Philip Gies Pump Company, of Kitchener, Ontario. This firm exhibits a Fry's visible petrol pump for accurately and automatically supplying and regulating petrol in given quantities. This pump, we understand, owing to its accuracy and visibility, has become an accepted standard in Canada and the United States. It can be operated either by hand, air, vacuum, or electricity. On this stand are also single and two-stage air compressors and air and water towers, to say nothing of garage equipment, including motor car jacks, engine stands, re-boring tools for Ford and Chevrolet cylinders, &c.

There are other exhibits which touch upon the engineering industry, but in the absence of a catalogue and in some cases of attendants the above outline may be regarded as a correct general summary of the more important, as far as the main Canada Building is concerned. There are, however, two other stands which should prove intensely interesting, the one to the home manufacturing engineer and the other to the student or the potential student of engineering. The first is the stand of the Canadian National Exhibition, already mentioned at the opening of this article. This colossal annual fair, which takes place in the latter part of August and the early part of September in each year, is but little known to English engineering firms, although, we understand, the few who use it do so with great regularity. It is, however, a happy and profitable hunting ground for American manufacturers. On this stand the British engineer will find all the data he requires beautifully set out pictorially in mechanically operated albums which turn over the pages for him as he inspects them, and further data can be had from the representative in attendance.

The other stand is the combined exhibit of the Canadian Universities, viz., Toronto, McGill, Queen's, Alberta, Saskatchewan, Dalhousie, New Brunswick, and Ottawa. Each of these universities has its engineering section, which is subdivided into seven departments, civil, mechanical, mining, electrical, metallurgical, chemical and architectural, for in Canada a scientific chemist and an architect rank as engineers. Between them they turn out hundreds of finished engineers annually, that of Toronto alone averaging 200 a year.

CANADIAN RAILWAYS.

We now come to the two separate buildings devoted to the exhibits of the Canadian Pacific Railway and the Canadian National Railways respectively. There is intense rivalry between these two great transcontinental systems, each with its vast network of subsidiary lines. By the courtesy of Mr. Bruce, the special representative of the former system, we show a plan of the Canadian Pacific Building. On the present occasion we shall confine ourselves to a brief reference to these two interesting and elaborate exhibits, as we hope to come back to them again. There is much in both buildings which merits a close study. In the Canadian Pacific Railway exhibit is the most wonderful electrical map that has ever been produced. Here, by means of some 5000 electric lamps of various colours, are depicted alternatively the ninety natural resources of the Dominion. The name of each product appears in large letters on a board and simultaneously all over the map of Canada appear the lights indicating the areas where the goods in question are produced. This map cost very many thousands of pounds to produce and took two years in the making.

A mechanical working model of the C.P.R. line shows miniature trains running round a portion of the building on an elevated railway. All the important points on the railway and steamer service between Liverpool and Yokohama are illustrated by mechanical and electrical vitascope models. There is also on the upper floor a cinematograph salon, which elaborates the data already seen on the map below by a series of carefully prepared films. The most interesting of these is the series which conveys an idea of the enormous present utilisation and future potentialities of the water power in various parts of the Dominion.

In the Canadian National Railways Building we find another elaborate electrical map. In this case, however, the purpose is different. It shows the journeys of the transcontinental trains by means of

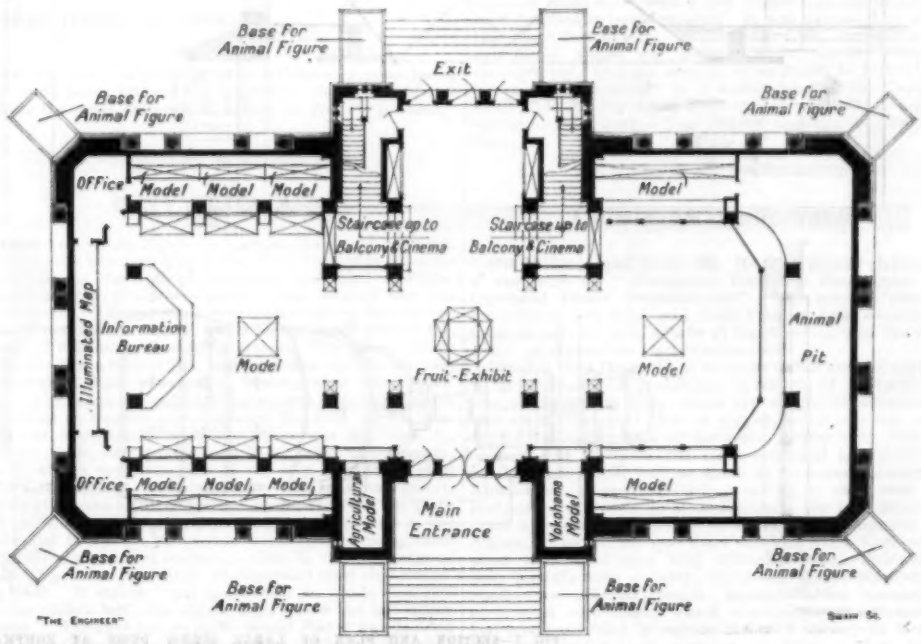


FIG. 80—PLAN OF THE CANADIAN PACIFIC RAILWAY BUILDING

running lights, which stop at the various points. Simultaneously with each stoppage a big picture comes into view depicting the town in question and the palatial hotel. Here the transcontinental journey is further illustrated by what is termed a triangular tour by means of a series of revolving models working

automatically and lighted with different colour effects which are operated from the map switchboard.

Although neither system is showing actual samples of its locomotives or rolling stock, there are models and pictures in abundance, including, in the National Building, a full-size model of parts of cars by which the sleeping and other *de luxe* accommodation is demonstrated. This section has also an elaborate cinema, where many subjects which will appeal to engineers are shown.

Well and practically arranged as is the whole of the exhibits in the Canadian Section, the man who wants to examine them thoroughly may well spend a couple of days in the process.

Some Large Dutch Drainage Pumps.

IN a paper on "Modern Pumping Engines in Holland," which he read recently before the Institution of Engineers and Shipbuilders in Scotland, Professor J. C. Dijxhoorn, of the Technical University, Delft, gave the following particulars concerning some large drainage pumps which were put to work a little over three years ago near the village of Zoutkamp on the Lauwer Zee. He explained that in 1915 the Government of Groningen, a province situated to the east of Friesland on the frontier of Germany, decided that three pumping engines, each capable of dealing with 33,333 cubic feet of water per minute, should be erected near that village, the water to be pumped into a lake of only one-quarter of a square mile in area, from which it would discharge into the open sea through sluices. The lift, it was pointed out, varies widely, but the capacity of the three pumping engines together will be 100,000 cubic feet, when the lift does not exceed 4ft. 3in. The mean lift may be taken at 3ft. 9in. It is intended to install two more pumping engines of the same capacity in the same building.

"The Board of the province," Dr. Dijxhoorn continued, "possesses its own electrical power supply at Helpman, a suburb of the city of Groningen, situated at a distance of about 18 miles from the pumping works, and a considerable consumption of electricity might be expected in this prosperous part of the country. It is clear that under these circumstances electricity was selected for the driving power, and the new boezem* even received the name "Electra." The great difference of lift, ranging from zero to 5ft. 9in., presented some difficulty in choosing the best system of pumps. With a steam engine driving a centrifugal pump, it is possible to work at a higher number of revolutions at the greater lifts, and at a reduced number at the smaller lifts. But with an ordinary three-phase motor the number of revolutions is nearly constant, and a motor suitable for standard conditions might be heavily overloaded under different circumstances, the gearing between the motor and pump shafts being unchanged. A variable speed gear might have been used, but it seemed hardly commendable for about 600 effective horse-power. The conditions of the prescribed capacity at different lifts could hardly be fulfilled with ordinary centrifugal pumps working at a nearly constant number of revolutions, and with a reasonable efficiency.

"Entrusted with the project for these pumping engines, I was of opinion that these difficulties could be avoided principally by the adoption of screw pumps. Such pumps for small lifts are constructed on the syphon system so generally applied to centrifugal pumps working under similar circumstances. They have proved very successful, especially in the district of New Orleans, where this system was introduced by Mr. A. B. Wood, mechanical and electrical engineer of the Sewerage and Water Board of that district. For very large capacities, this system of screw pumps presented several advantages over centrifugal pumps when considering the circumstances of the 'Electra' pumping engines, and so I had no hesitation in adopting it.

"An advantage of fundamental importance already mentioned is that when working at a constant speed, but with widely different lifts, the power required for driving a screw pump varies less than that for driving a centrifugal pump of ordinary construction. On passing through a screw pump, the water is not liable to so many changes of direction as when passing through a centrifugal pump. The main flow in the latter enters the pump axially, passes the blade wheel radially, and is discharged tangentially. In the screw pump—Figs. 1 and 2—the main flow of the water is axial only. The result is that smaller losses of head, caused by friction, whirling, &c., might be expected with a well-constructed screw pump than with a centrifugal pump. For pumps working with very small lifts, these losses represent a great percentage of the actual lift, and, consequently, a more favourable efficiency with screw pumps might be expected than with centrifugal pumps, especially at very small lifts.

"The simpler form of the pump casing and of the adjoining pipes induce the designer to make all cross sections of ample area, and there is no great difficulty in building units of much greater capacity than is possible

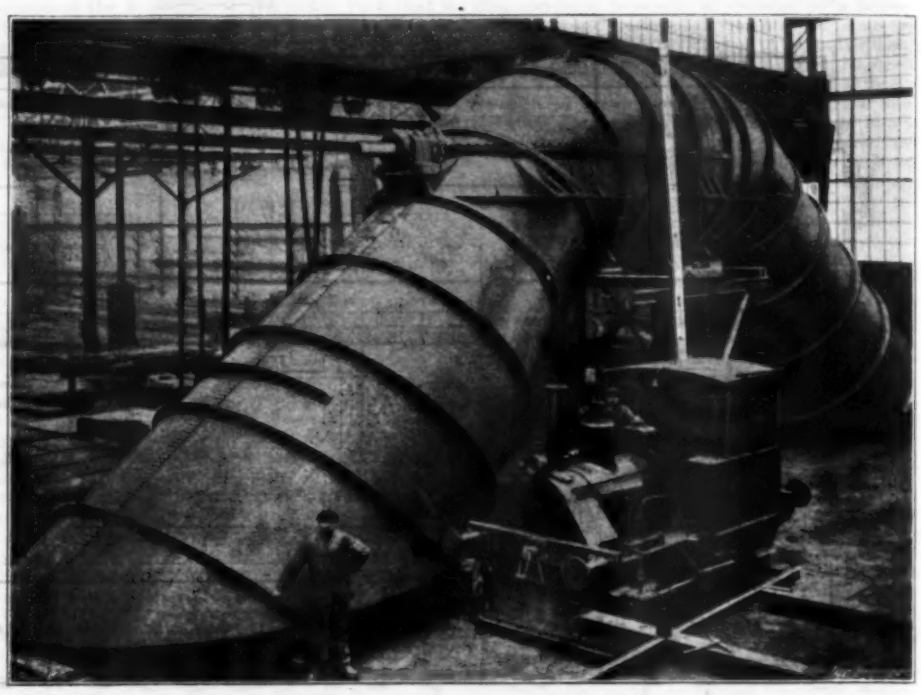


FIG. 2—ONE OF THE PUMPS ERECTED IN THE SHOPS AT HENGELO

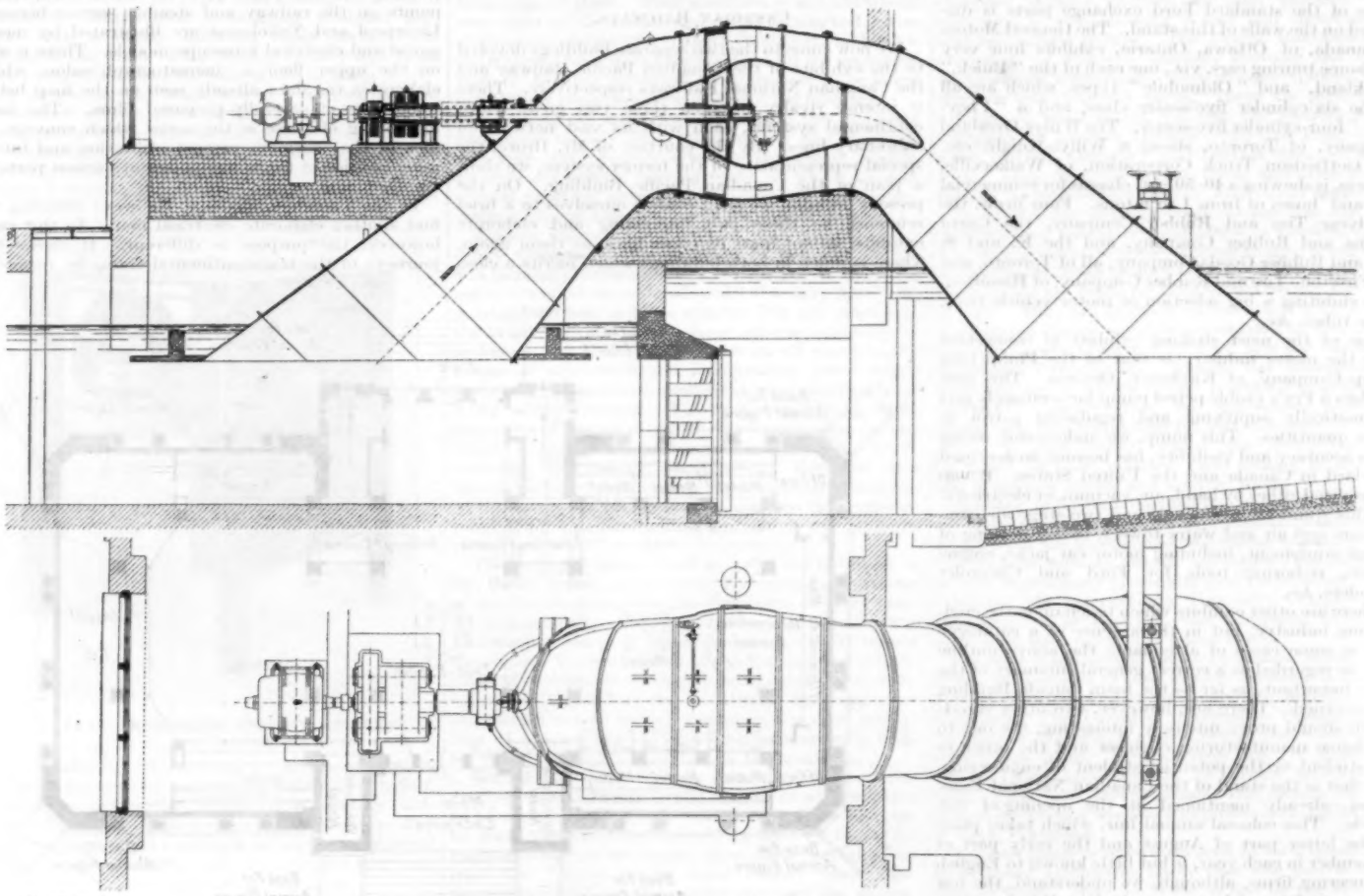


FIG. 1—SECTION AND PLAN OF LARGE SCREW PUMP AT ZOUTKAMP, HOLLAND

* NOTE.—A *boezem* is an intermediate reservoir between the pumping station and the sea or river into which the water is eventually delivered.

with centrifugal pumps of reasonable dimensions. As a consequence, screw pumps, each for discharging 33,333 cubic feet of water per minute, were adopted for the 'Electra' pumping works, and a notable economy in the dimensions and cost of the building was thereby secured.

"The general arrangement of one of the 'Electra' pumps is shown in Fig. 1. The pump as a whole is a syphon pipe, and consists of a horizontal section containing the working part of the screw pump, the adjoining inlet and discharge pipes being inclined at an angle of about 45 deg. In the horizontal section the screw is keyed to a horizontal shaft, and in the direction of the water flow there is a circle of curved guide blades which lead the water again in an exactly axial direction. Only the outside ring section of the pump is active; the central part is hollow and double pear-shaped—*vide* the longitudinal section. The centre piece of the pump wheel is conical, in accordance with the adjoining centre piece of the pump itself. The pump casing and its centre piece are made in cast iron segments. There is a horizontal flange joint at the centre line in order to make the pump wheel and the bearings of the shaft at both sides of the wheel readily accessible. These bearings are lubricated from the outside. The centre piece of the pump wheel is of cast iron also. The screw blades are made of steel plate, $\frac{3}{4}$in. thick, strongly fixed to flanges on the conical centre piece, and are joined by angle iron, $\frac{3}{4}$in. thick, to the conical rim plate of the wheel. The inside diameter of the wheel at the discharge side is 11ft. $7\frac{1}{2}$in.

"The inlet and the discharge pipes are constructed of steel plate stiffened by T-iron rings riveted at the outside. The conical suction pipe is from 12ft. 9in. diameter at the inlet opening to 9ft. 10in. diameter at the connection with the pump casing. The conical discharge pipe widens gradually, with increased evacuation. This is an advantage when using an electric drive, especially with a high voltage and a long cable, a sudden overloading of which is to be avoided.

"Each pump is provided with an emergency valve in order that air may be let in automatically, and, consequently, the pump will be emptied if the electric current should fail.

"Under the conditions prevailing in 1918, the difficulties in completing an aerial line 18 miles in length from the power-house to the pumping works, for driving three pumps at full power, were such that a cable of a smaller capacity was laid instead, and a provisional steam plant was installed for generating the electric current for driving at full power. This provisional installation was built on the site of the fourth and fifth pumping engines, to be erected later.

"The hall containing the three enormous pumping engines gives an impression of extreme simplicity, considering that 100,000 cubic feet of water pass through it each minute. Fig. 3 shows the hall decorated with plants, &c., just before the arrival of the Queen of Holland and the Prince Consort on November 5th, 1920, for the official opening of the installation.

"The results of trials of the three pumping engines may be summarised as follows, the figures being the exact averages with lifts varying from 2ft. $1\frac{1}{4}$in. to 4ft. $3\frac{3}{4}$in.:—

Revolutions of pump shaft per minute	53.2
Mean lift of pump, inches	44
Water discharged by each pump per hour, cubic feet	35,564
Water horse-power developed by each pump ..	246.4
Mean kilowatt for one pump motor	341
Kilowatt per water horse-power	1.38

FIG. 3—INTERIOR OF DRAINAGE PUMPING STATION AT ZOUTKAMP

from 9ft. 10in. to 13ft. 2in. at the immersed discharge mouth.

"Fig. 2 gives a good impression of the size of one of the pumps as it stood in the erecting shop of the engineering works of Stork Brothers, Hengelo. The mouth of the suction pipe, as well as that of the discharge pipe, is horizontal. Undoubtedly, inlet and outlet openings, like those of the Lemmer pumping works, where the direction of the inlet and the outlet flow of water is horizontal, are more favourable generally, but in the case of the 'Electra' pumping works there was another consideration that led to the arrangement adopted. The five free openings for discharging the water of the boezem without pumping have each a width of 20ft., and are under the pumping engine building. Over each of these openings is a heavy block of reinforced concrete, and three of these blocks form the foundations for the pumps and the electric motors which have been erected so far. The position of the pump wheels is exactly above the sluices in the free outlet openings. To avoid any obstacle to the free flow of water through the sluice openings, it was judged best to make horizontal end openings to the inlet and discharge pipes of the pumps. The end thrust on the pump shaft is taken by a Michell block fixed to the pump casing.

"At normal load the three-phase 3000-volt electric motor runs at 978 revolutions per minute. The power is transmitted to the pump shaft working at 53 revolutions per minute by a double gear. Forced lubrication for the bearings and the gearing is maintained by a pump driven by toothed gearing in the main gear casing. A point of interest is the starting of the main pumps. These are filled by evacuation of the casing while starting the motor, as is done with the steam-driven Lemmer centrifugal pumps, but with this difference, that the vacuum pumps are now electrically driven. But there is another difference with respect to the effect of evacuation on the main pump. When the water level is rising in a centrifugal pump which is running at a speed that approaches the regular number of revolutions, then at a certain moment the pump starts full delivery, the pump wheel working equally along its whole circumference.

"When a screw pump of the construction described is evacuated in the same way, the pump is first working at a quarter of the blade wheel diameter, then at a half of this diameter, and so on, the load on the motor increasing gradually, with increased evacuation. This result may be judged highly satisfactory, considering the small mean lift and the important change of this lift during the trials, amounting, in fact, to over 100 per cent."

SIXTY YEARS AGO.

GUNNERY in the Navy sixty years ago would not seem to have been of a very high order, if we may judge from the description of the trials of two guns, carried out at Portsmouth in 1864, which was given in our issue of May 6th of that year. The two guns were both made by Armstrong. One, which we will call A, had a smooth bore with a diameter of 9.22in., and weighed 6 tons. The other—let us call it B—had a bore of 7in., and was rifled on "Sir William Armstrong's shunt principle." It weighed 6 tons 13 cwt. 3 qr. The range was only 200 yards, and of the two plates employed as targets, one measured 9ft. 11in. by 3ft. 8in. and was $5\frac{1}{2}$in. thick, while the other was 8ft. 10in. by 3ft. 5in. wide, and it, also, was $5\frac{1}{4}$in. thick. Apparently, the first shot fired was one of the best aimed. A steel spherical projectile, weighing 115 lb., was sent from gun A, with a charge of 30 lb. of powder, and it "struck the plate full on its right centre, and partially turned round in the plate and broke up, its broken outer surface being flush with the plate's outer surface." Gun B, with a charge of 25 lb. of powder, next fired an elongated steel shot weighing 98 lb. It struck "not quite with its whole diameter on the plate's left edge about 15in. below the left upper corner." The shot was so badly aimed that it was decided to send another from the same gun. The second shot "struck in the immediate vicinity of the last." The next round was with a spherical steel projectile from gun A. It struck close upon the lower edge of the plate. Gun B then had a try. Its elongated shot hit the upper edge of the plate. Then it tried again, and had better luck, for it hit the plate sufficiently fully to embed itself for half its length in it. The next and last shot of the day was made from gun B, with a 98 lb. Armstrong elongated shell containing a bursting charge of 1 lb. 14 oz. Again only the edge of the plate was hit, and though the projectile burst, but little damage was apparently done. "The indent on the plate at the deepest part was only 4in., and although the shell must have exploded at the moment of reaching the deepest part of its indentation into the plate, the metal was but insignificantly affected by it; in fact, this shell only proved to be what shells in general have often proved before—harmless against armour-plating." The issue from which we are quoting also contains an article on "Parliamentary Fees and Deposits." "Whatever be the quality of justice which Parliament dispenses to the suitors who appear at its bar in connection with private Bills, it must," we read, "be owned that it is a costly luxury. Of late years we have seen the revival of an old practice, and the appearance of the State, in various capacities, as a trader with an eye to profit. It has entered into competition with carriers and bankers, and is about to become a rival to the insurance offices. It not only pays its expenses, but makes a profit out of private Bill business. . . . The cost of the establishments, includ- the Speaker, Chairman of Ways and Means, the Sergeant-at-Arms, clerks, messengers and all the numerous and well-paid staff, is about £58,000 odd annually. This is not paid out of the Consolidated Fund, but out of the private Bill fees and consequently falls mainly on the railway companies of the country."

RAND MINES GOLD OUTPUT.

THE output of the gold mines of the Transvaal for March has been declared at 795,671 fine ounces, an increase on February of 35,054 oz., and only 1097 oz. behind the record output made in January last. The Rand output was 774,347 oz., an increase of 34,970 oz., while the output of the outside districts in the Transvaal was 21,324 oz., an increase of 84 oz. The March value was £3,809,275, an increase of £196,344 upon that of February.

The bare facts as stated above are apt to prove misleading unless all the circumstances are kept in mind. The most important of these is that February had only twenty-five working days, and March, although it has thirty-one days in all, had only twenty-six working days this year, owing to the fact that there were five Sundays in it. It follows therefore that as the February output was 760,617 oz. for twenty-five working days, the daily average for February was 30,425 oz., and for March, with twenty-six working days, the average daily output was 30,603 oz., —an appreciable improvement.

Taking the first quarter of this year, it certainly looks as if 1924 is going to set up another record output of gold, even if the value, owing to the decrease in the gold premium, may not be a record. The comparative figures, in ounces, for the first three months of 1923 and 1924 are as follows:—

	1923.		1924.
January	764,469	..	796,768
February	704,970	..	760,617
March	761,586	..	795,671
	2,231,025	..	2,353,056

Or a gain for 1924 of 122,031 oz. The value of the output for the first quarter of 1923 was £9,530,671, while for the first quarter of 1924 it was £11,000,747. It must, however, be pointed out that while the value at which gold is now being taken is around £4 15s. per ounce each month, it was only around £4 7s. to £4 7s. 6d. for the same three months of last year. Making every allowance, however, it is clear that 1924, always provided that some severe and unexpected catastrophe does not overtake the Rand goldfield, will be a record year as far as production is concerned. For it must not be forgotten that some schemes for increasing the outputs of mines, now in full swing, will be in working order before the end of the year, and that the West Springs will shortly become a large producer, and upon no small scale, seeing that 50,000 tons per month of rock crushed is contemplated. It was proposed to start this plant last month. Several mines are engaged upon extensions, which will increase their monthly outputs considerably. In some cases an extra 10,000 to 20,000 tons of ore will be crushed. It is stated also that the Government Gold Mining Areas contemplate gradually bringing up the monthly output from 150,000 tons to about 200,000 tons.

ALUMINIUM CONDUCTORS.

On Friday, April 25th, Mr. H. G. Williams delivered a lecturette on "Aluminium Electrical Conductors for Overhead Power Transmission." The lecturer treated the subject very fully, and dealt with financial considerations as well as with details of construction and the efficiency of aluminium transmission lines.

He said that the ratio of cross-sectional area of copper to its equivalent in aluminium in respect of conductivity was about 100 to 159. Since the weight of aluminium was about one-third that of copper, an aluminium conductor having an area 59 per cent. greater than that of copper, and therefore the same electrical conductivity, would weigh about half as much as a copper conductor. Aluminium showed a distinct saving in first cost of material, and by virtue of its lightness, the load imposed upon structures was much less than that imposed by copper. The saving was more marked when high pressures were used over long distances, and particularly over mountainous country, since the use of aluminium conductors allowed longer spans. Cables consisting of a steel core round which aluminium was stranded had now been tried in service in such a variety of localities and under such varying conditions, that their reliability and efficiency had been demonstrated without doubt. It was important that the steel wire should be galvanised to prevent electrolytic action and to prevent corrosion of the steel.

As regarded the effect of the weather and the atmosphere on aluminium conductors, it was pointed out that hydrochloric acid or strong caustic soda vapours would dissolve the metal, and that if aluminium cables were brought into contact with copper or brass wires or clamps in the presence of moisture, there would be electrolytic action. Galvanised iron or aluminium fittings had,

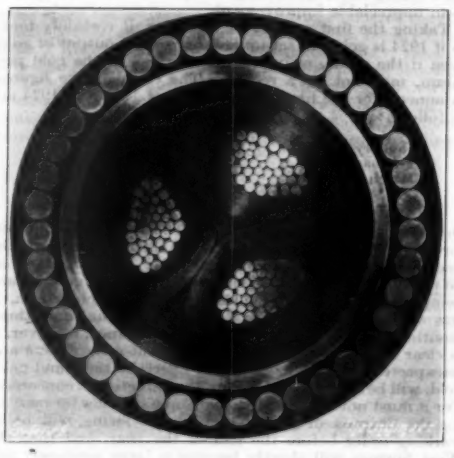
therefore, to be used. There were, it was stated, numerous cases in which aluminium cables had been in service for many years on the sea coast, on steam railways, and near coke ovens, without any deterioration. Troubles were often traced to impurities in the metal.

Extra High-tension Cable for the Morwell Power Scheme.

THE first stage of the Morwell power scheme, which is now nearing completion, comprised the laying of some 50 miles of three-core paper-insultated, lead-covered and armoured cable, having a section of 0.15 square inch per core, and designed for a working pressure of 22,000 volts. Over 35 miles of cable have already been satisfactorily laid, tested, and placed in commission.

The Morwell power station, it will be remembered, is being built by the Victorian Government and is particularly interesting in that it is designed to burn brown coal. It was described in our issue of February 16th, 1923. From the auxiliary power station at Newport B. to the terminal house at Yarraville the route of the transmission line follows the right bank of the river Yarra. For more than half this section the trench in which the cable is laid and which is 7ft. wide runs through solid rock, and in places it is excavated to a depth of 12ft. For the supply to Melbourne three cables are laid from Yarraville to the City Council's sub-station at Spencer-street, and two others to the sub-stations at Ascot and Royal Park. At Footscray all five cables cross the bed of the Maribynong River. From that point the Spencer-street cables are carried 2 miles across the West Melbourne Marshes on a specially constructed embankment to the Coal Canal Lagoon, across which lengths of submarine cable were floated by barrels and rafts hauled by power winding gear. The whole of this operation was completed in one day. The illustrations on page 510 show the work in progress; similar methods were employed at the Maribynong River.

The whole of the 50 miles of 22,000-volt cable was manufactured, and the laying, jointing, and testing supervised, by Siemens Brothers and Co., Limited, Woolwich, for the State Electricity Commission of Victoria. The cables were



SECTION OF THREE-CORE 22,000 VOLT CABLE

tested with alternating current at a pressure of 50,000 volts at the manufacturers' works at Woolwich, and with 44,000 volts alternating current after being laid and jointed. A section of the cable is shown in the accompanying illustration. It applies to the whole length of 50 miles, excepting to those portions where the cable passes across the Coal Canal Lagoon and the Maribynong River, for which the armouring is double.

Empire Mining and Metallurgical Congress.

AN Empire Mining and Metallurgical Congress will be held on June 3rd, 4th, 5th and 6th next, at the British Empire Exhibition, under the auspices of the Institution of Mining and Metallurgy, the Institution of Mining Engineers, the Institution of Petroleum Technologists, the Mining Association of Great Britain, the Iron and Steel Institute, the Institute of Metals, and the National Federation of Iron and Steel Manufacturers.

The following programme has been arranged:—On Tuesday, June 3rd, at 11 a.m., the opening session of the Congress will take place in Conference Hall No. 1 at the Exhibition. The President, Viscount Long of Wraxall, will deliver an address on "Mineral Resources and their Relation to the Prosperity and Development of the Empire," after which a selection of papers will be read and discussed. In the afternoon, at 2.30 p.m., the President and members of the Congress will visit the mineral exhibits of the Dominions, India, the Crown Colonies, the coal-mining industry exhibit, and the underground workings and equipment of the model colliery. In the evening, at 8.30 p.m., there will be a reception at the Imperial College of Science and Technology—in the Royal School of Mines Building, Prince Consort-road, South Jensington—by invitation of the Rector, Sir Thomas H. Holland, F.R.S., and Lady Holland. On the Wednesday, at 10.30 a.m., sectional sessions for the discussion of papers will be held in Conference Halls No. 1, 2, 3 and 4, at the Exhibition, and will be continued during the afternoon. At 8 p.m. the "May Lecture" of the Institute of Metals will be delivered by Dr. F. W. Aston, F.R.S., whose subject will be "Atoms and Isotopes," in the Hall of the Institution of Mechanical Engineers at Storeys-gate, Westminster. On the Thursday, at 10.30 a.m., the sectional sessions will be resumed, and will be continued, with an interval for luncheon, till 4.30 p.m. At 7.45 p.m. an official banquet will be held at the Guildhall to meet his Royal Highness the Prince Arthur of Connaught, and the official delegates and members of the Congress from Overseas. On the Friday, at 11.30 a.m., the concluding general session of the Congress will be held in Conference Hall No. 1, for the consideration of resolutions and other business. At 3.30 p.m. the Wardens and Court of the Goldsmiths' Company will entertain at an afternoon party the official delegates and members from overseas, with their ladies, and a limited number of home members, with their ladies, at Goldsmiths' Hall, City of London.

Papers have been arranged by Overseas Institutes on mining and metallurgical practice in (*a*) Canada; (*b*) Australasia; (*c*) South Africa"; and the following papers have been received or promised:—

Section A, Mining: (1) "Economics of the Coal Mining Industry," by Evan Williams"; (2) "Economics of the Metalliferous Mining Industry," by Professor Henry Louis and Hugh F. Marriott; (3) "Researches on Safety Problems in Mining": (*a*) Introduction by Sir Edward Troup (chairman of the Safety in Mines Research Board), with sections dealing with: (*b*) "Coal-mining Explosives," by Sir Frederic Nathan; (*c*) "Spontaneous Combustion of Coal," by Dr. J. S. Haldane; (*d*) "Fire-damp Explosions" by Professor H. B. Dixon; (*e*) "Coal-dust Explosions," by W. Mason; (*f*) "Electricity in Coal Mines," by Robert Nelson; and (*g*) "Miners' Safety Lamps," by Dr. R. V. Wheeler; (4) "Physiological Problems in Mining," by Dr. J. S. Haldane; (5) Miners' Nystagmus—Its Prevention and Cure," by Dr. T. Lister Llewellyn; (6) "Ventilation in Mines," by Professor Douglas Hay and Robert Clive; (7) "Provision of Compressed Air in Mines," by Edmund L. Hann; (8) "Mechanical Problems in Coal-getting," by Sam Mavor; (9) "Preparation of Coal for the Market," by F. S. Sinnatt and H. Eustace Mitton; (10) "The Mining and Treatment of Zinc-Lead-Silver Ores at the Sullivan Mines, British Columbia," by S. G. Blaylock and others; (11) "Treatment of the Gold-bearing Quartz of the Kolar Goldfield," by R. H. Kendall and A. F. Hosking; and (12) "Tin-mining in the Federated Malay States," by L. G. Attenborough.

Section B, Petroleum: (1) "Economics of the Oil Industry," by Sir Robert Waley-Cohen; (2) "Petroleum Geology," by T. Dewhurst; (3) "Petroleum Engineering—Drilling," by A. Beeby Thompson; (4) "Petroleum Engineering," by C. Dalley; (5) "Crude Oils of the Empire," by Dr. A. E. Dunstan and James Kewley; (6) "Refining of Oil Shale," by Edwin M. Bailey; (7) "Oil Transport—Tankers and Pipe Lines," by Herbert Barringer; and (8) "Bulk Distribution of Oil—Depôts and Bunkering," by Sir Frederick W. Black.

Section C, Metallurgy of Iron and Steel: (1) "Economics of the Iron and Steel Industry," by Sir William J. Larke and M. S. Birkett; (2) "Development of the Iron and Steel Industry in Canada," by C. S. Cameron; (3) "The Iron and Steel Industry in India—Its Rise, Present Position and Future Prospects of Development," by H. M. Surtees Tuckwell; (4) "British Iron and Steel Industry," by F. W. Harbord and E. F. Law; (5) "Modern British Blast-furnace Practice," by F. Clements; (6) "Fuel Economy in Iron and Steel Works," by Sir R. A. Hadfield; (7) "A Comparative Survey of Coke-oven Practice in Various Countries," by G. Hebden; (8) "Modern Developments in the Metallurgy of Special Steels," by W. H. Hatfield; (9) "Railway Steels," by E. H. Saniter; and (10) "The British Cast Iron Research Association—Its Present Work and Future Development," by J. G. Pearce.

Section D, Non-ferrous Metallurgy: (1) "Aluminium and Light Alloys," by Dr. W. Rosenhain; (2) "Metallurgical Research in Government Laboratories," by Dr. J. L. Haughton; (3) "The Work of the British Non-ferrous Research Association," by Dr. R. S. Hutton; and (4) "Metallurgical Education of University Rank in Great Britain," by Professor H. C. H. Carpenter.

Australian Engineering Notes.

THE Brisbane Tramways Board has accepted the tender of Dorman, Long and Co. for the manufacture in England of a further 1500 tons of tram rails and fastenings for delivery after the completion of the present contract for 15,000 tons.

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NEW cloth mills are to be established in Geelong (Victoria) by the Valley Worsted Company. The new mills will be, it is stated, the biggest on the south side of the equator, and will cost over £500,000.

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CONTINUING its policy of railway expansion the South Australian Government has accepted the tender of the Broken Hill Proprietary Company for 29,367 tons of 60 lb. rails and 2241 tons of fish-plates, at a cost of £390,000.

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THE Chairman of the Melbourne Tramways Board has announced that the Board is proceeding immediately with the conversion of the cable trams to electric, at a cost of £4,000,000.

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MUCH success has attended the innovation by the Victorian and New South Wales railways of motor trains in country districts. Many lines, which previously made a loss on running, are now paying their way. The New South Wales Minister for Railways recently said that the motor trains had been so satisfactory that an order had been given for the construction of a further number. Since they have been in commission traffic has increased greatly.

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To meet the increasing demand in Australia for cement, the Sulphide Corporation, Limited, of Newcastle, N.S.W., is putting down a plant capable of producing 30,000 tons of cement annually. The factory is so designed that provision is made for two, and, if necessary, three additional units, increasing the output to at least 60,000 tons per annum. The expenditure contemplated totals £200,000.

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THE Commonwealth Minister for Railways (Mr. Stewart) has inspected the route of the proposed extension of the railway line from Oodnadatta to Alice Springs in the Northern Territory. The Federal Public Works Committee has recommended the construction of a line of 3ft. 6in. gauge with 60 lb. rails. The estimated cost of the line was £4,109,446, but it was ascertained that by using second-hand rails the line could be constructed for £1,558,600. The fourteen locomotives which are being constructed by Thompson and Co. are for the Port Augusta-Oodnadatta section.

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THE Tasmanian Legislative Council has agreed to pass a vote of £10,500 as a contribution towards the cost of the Ralph's Bay Neck Canal, on the south coast of Tasmania. The Government now has parliamentary authority to call for tenders for the work and to accept any which will not involve the State in an expenditure of more than £30,000. The canal will give more direct water communication between Hobart and an important district in the south-east.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

MACHINE TOOLS AT THE EXHIBITION.

SIR,—During the past two years we have heard many complaints regarding the stagnation in the British machine tool trade, and no doubt there was grievous cause for despondency, but it would have been thought every effort would be made to advertise the productions of the machine tool manufacturer of this country to the fullest extent possible, more especially in view of the number of foreign visitors and buyers who would be visiting England this year. I am, therefore, grievously disappointed at the attitude of this trade generally towards the British Empire Exhibition.

I am about to purchase on behalf of a railway company some additional equipment, comprising wheel-turning lathes, axle-turning lathes, journal-turning lathe, tire-boring machines, a universal milling machine, a radial drilling machine, and some tool-room equipment, including centre lathes, grinding machine, hardening furnace, micrometers, &c., and in the hope of being able to view the latest types of these various machines I visited the Palace of Engineering, British Empire Exhibition, this morning. As far as I could see there was only one stand showing machine tools of the type in which I am interested, and I was informed by the Machine Tool Association that no exhibits were being shown at Wembley, as it was considered sufficient advertisement would be gained in the Machine Tool Exhibition to be held at Olympia in September. I was unable to obtain a list giving the names of the members of this Association, or any information regarding their manufactures, and, generally, my visit was fruitless, with the exception of the information and courtesy I received at the one stand already mentioned.

No doubt the British machine tool manufacturers know their own business best, but there will be surely many other potential buyers similarly situated to myself, and few of them will feel disposed to wait until September in order to see the exhibits of British manufacturers. Had manufacturers from foreign countries been allowed to exhibit, I feel sure they would have been to the forefront in displaying their wares so as to interest probable customers. There is every chance that the foreign visitor to Wembley will return home thinking the only machine tools which he can purchase are those made in America and other countries. It is a pity this impression should be created, and such a fine chance for advertising British machines be lost.

May 7th. C. M. E.

RAILWAY ELECTRIFICATION.

SIR,—Mr. V. E. Williams, Johannesburg, South Africa, complains in your number of March 28th that a clear view of the relative merits of the several systems of electric traction has been obscured. He finishes his letter with the remark that whatever the change may be, direct current at 3000 volts will solve the main-line traffic question as economically as any other system, and according to his opinion this is the least that can be claimed for this system.

What is, then, to solve the main-line traffic question? I am very sorry I cannot agree with Mr. Williams about the requirements in this case. According to my opinion, it is necessary to find a system for the railway electrification that makes it possible to operate motor cars with down to, say, 10 horse-power, and locomotives with horse-power up to 20,000 if necessary, as for the new locomotives for the Virginian Railroad in America which are now being built. It is also necessary that the electric energy from the contact lines can be used for the lighting and heating of the trains. The only system that can fulfil all these requirements is, as far as I can see, the single-phase system.

The 3000-volt direct-current system has too high potential for the small motor cars and too high current for the biggest locomotives, and 3000-volt direct current can hardly be used in general for train heating.

With the single-phase system, it is very easy to reduce the potential by means of static transformers, and therefore both the potential and current can be kept within practical limits for every case, small motors can be operated as well as big ones, and the current can be used for train heating without any difficulty or danger.

The single-phase system can now, according to Swedish experience, be arranged so that there will be practically no interference on communication circuits paralleling railways electrified with this system of current. The Nordmark-Klarälven electrification, 150 kiloms. in length, has already proved this, and the Stockholm-Göteborg electrification, 460 kiloms. in length, will be built according to the same principles.

According to these new principles, the feeding points for the railway contact lines can be placed at distances of from 100 kiloms. to 300 kiloms. In most cases, no transmission lines are necessary along the railway, and motor generator stations operated from the main three-phase network can be arranged for supplying the necessary single-phase current for the railway, with a good economical result.

The 3000-volt direct-current system requires, according to our opinion, too many motor generator stations.

Stockholm, Sweden. I. OFVERHOLM.

Railway Matters.

FROM June 2nd the King's Cross–Harrogate–Newcastle Pullman train will also serve Bradford and on the same date a Marylebone–Nottingham–Sheffield service will be instituted.

THE Minister of Transport was recently asked if he would consider the question of appointing a Royal Commission to re-examine the Gattie scheme. Mr. Gosling replied that those proposals were the subject of an exhaustive and impartial inquiry four years ago, and he saw no reason for arranging that they should be further investigated as suggested.

WE regret to hear of the death of Commander G. J. Baugh, D.S.O., R.I.M., the superintendent of the Fleetwood and Belfast services of the London, Midland and Scottish Railway Company. Commander Baugh was appointed marine superintendent at Fleetwood by the Lancashire and Yorkshire and the London and North-Western Railway Companies in 1907 as successor to Captain Jackson, and did some very good work during the war, along with his old colleague, Commander Holland, in the Inland Water Transport.

IT is stated that 250,000 tickets a day are issued upon the Underground by automatic machines of various types. An order for thirty additional Rolltic machines, which has just been placed, will increase this figure to 350,000. The following figures show the yearly number of tickets which are now being issued by mechanical aids at a few of the important interchange stations:—Victoria, 2,280,000; Waterloo, 2,345,000; Oxford-circus, 2,910,000; Piccadilly-circus, 3,000,000; Finsbury Park, 1,020,000; and Tottenham Court-road, 1,200,000.

ANSWERING a deputation from Brighton and Hove as to alleged grievances and asking for further railway facilities, Mr. Cox, the chief operating superintendent of the Southern Railway, said it was entirely incorrect to say that the Brighton section was receiving less consideration than the other two sections of the Southern Railway. But as long as the group had differing types and dimensions of engines and carriages on the respective sections, and the Brighton section used the Westinghouse brake, it was not possible to obtain full benefit of the rolling-stock facilities which would otherwise be practicable. Considerable progress had already been made and the company had given orders for the construction of a large number of modern corridor carriages.

DURING the war frequent references were made herein to the lines that were laid to connect the collieries at Athy and Wolfhill in Ireland to the main line, so as to reduce the tonnage necessary to carry coal from British ports to Ireland. The Great Southern and Western Railway Company converted some of its double line into a single track in order to get the necessary material, and the Board of Trade undertook to furnish new rails, sleepers, &c., when it was necessary to restore the road for double-line working. The Ministry of Transport, which succeeded the Board of Trade in this matter, disclaims liability, in view of the status of the Irish Free State. The railway company thereupon presented a petition of right, but Mr. Justice Rowlatt dismissed it. The company applied to the Court of Appeal, and its appeal has been allowed.

WHAT was the *Victorian Railways Institute Review* has now become the *Victorian Railways Magazine*. In the issue for January last—the first of the new series—was an article headed "The Growth of a Huge Business: Invested Capital, £65,000,000; Income, £11,500,000." It gave a history of the Victoria Government Railway, which began its career in September, 1854, with a railway, 2¼ miles long, from Melbourne to Port Melbourne. It was the first railway in Australia. The Government Railways now employ 26,745 men, carry 146 million passengers a year in the Melbourne area alone—all in electrically operated trains—handle 3000 trains and 240,000 passengers each day in Melbourne Central Station, have converted 349 miles single track from steam to electric operation, possess 815 locomotives (some weighing 127½ tons), passenger coaches 71ft. long, 737 cars for the electric service and use 100 lb. per yard rails.

INCLUDED in the London and North-Eastern Company's Bill was an application for powers to effect certain improvements at Frodingham, with a view to facilitating the ironstone traffic. The cost was estimated at several thousand pounds, and the proposed works included not only a new station, but the substitution of a bridge for a busy level crossing. The local authorities were in agreement, but two or three property owners pressed for the insertion of clauses that would give them compensation which they were otherwise not entitled to. The Parliamentary Committee considering the Bill approved these clauses, and the railway company now announces that the decision is so marked a reversal of the accepted practice, and that its effects on the alteration of the law of compensation would be so far-reaching, that it has reluctantly decided that it cannot proceed with the Bill so far as the new railway and works at Frodingham are concerned, and consequently has no alternative but to withdraw the powers from the Bill.

ACCORDING to the Board of Trade returns, the value of the railway material exported during the first two months of the present year was as follows, the corresponding figures for 1923 and 1922 being added in parentheses:—Locomotives, £401,667 (£615,435, £1,435,859); rails, £438,153 (£341,071, £656,589); carriages, £226,121 (£272,581, £231,004); wagons, £643,906 (£414,979, £1,064,409); wheels and axles, £125,393 (£113,501, £246,027); tires and axles, £133,394 (£64,698, £117,115); chairs and metal sleepers, £264,306 (£81,260, £378,060); miscellaneous permanent way, £268,871 (£186,995, £312,147); total permanent way, £1,230,177 (£787,525, £1,709,938). The weight of the rails exported was 46,596 tons (35,101 tons, 54,101 tons), and of the chairs and metal sleepers, 20,591 tons (7400 tons, 23,712 tons). During February alone, locomotives to the value of £126,355 were shipped to India and of £23,520 to other countries in South America than the Argentine. Rails to the value of £56,841 were shipped to India, of £19,831 to Ceylon, £11,176 to South Africa, £10,039 to New Zealand, and £9361 to Australia.

Notes and Memoranda.

THE number of applications for patent rights in this country during last year was 32,621, which shows a decrease of 2873 on 1922.

IT has been found in America that the temperatures under which charcoal blast-furnaces are operated are lower than is permissible in coke practice. Furthermore, it was learned that the principal factor in causing this difference is the low-sulphur content of the charcoal compared with the higher quantity of sulphur present in coke. In fact, the effect of sulphur in the blast-furnace charge is even more important than was hitherto believed.

IT is said that the report of the Air Survey Committee, which will be issued shortly, does not favour surveying from the air, as being economical or efficient, except in conjunction with other means of survey. Photographic faults and the impossibility of keeping at an absolutely uniform height from the ground may, it is realised, be responsible for inaccuracies in the survey plans. For making maps of flat land, however, the use of aeroplanes is recommended by the Committee.

RECENTLY the members of the Western Centre of the Institution of Electrical Engineers paid a visit to the power station at Lydney. The visit was also the occasion of the first joint meeting of the Institution of Electrical Engineers and the South Wales Branch of the Association of Mining Electrical Engineers. Following the inspection of the new power station, Professor W. M. Thornton submitted a paper on "Some Researches on the Safe Use of Electricity in Coal Mines," which he illustrated by a number of interesting experiments and lantern slides. He also gave a demonstration of his electric lamp, which indicates the presence of gas in coal mines, although he admitted that it was not yet an article of commerce.

THE mining bureau of Mukden, Manchuria, has opened two coal mines in the district of Fengtien, west of the Liao River. The first, which is in the foothills west of Koupangtzu Junction on the Peking–Mukden Railway, has been in operation over a year. Already the initial expenses are being repaid by the output of coal from the four working pits, according to the *North China Daily News*. An expedition to bore for coal at or near a mine 13 miles west of Takumen has recently been dispatched, and preliminary surveys have convinced the explorers that there is a wide field in the neighbourhood. At present the operations are hampered by a considerable depth of water. If the yield turns out as satisfactory as is expected, this mine will, like the first, be connected with the Peking–Mukden Railway. To the nearest station, Hsinmintun, a line of some 53 miles would be required.

CAREFUL observations made in an American power station are said to have shown that, with air heating, the fuel bed in the stoker was more uniform, the fuel ignited and burned more readily, as shown by a series of elaborate analyses indicating that the amount of unburned material in the ash was reduced by from 6 to 12 per cent. Also the tendency to clinker formation was reduced, and the ash and clinker itself was cleaner and more easily handled. Further, it was shown that the amount of CO_2 in the flue gases was increased by from 0.7 to 1.4 per cent., depending on the rating, whilst at the same time the exit gases from the boiler and the superheater were reduced by from 10 deg. to 14 deg. Fah., in spite of the fact that the temperature of the air entering the furnace was 235 deg. Fah. instead of 60 deg. Fah. The amount of power used by the circulating fan was found to average 5 kilowatts per ton of coal, or approximately equivalent to 0.4 per cent. of the steam production of the plant.

THE inadequacy of the milliammeter and spark gap as means of measuring the quantity and quality of the radiations from X-ray tubes of different types and under various conditions of excitation has been felt by all radiologists, but no more trustworthy methods which are at the same time convenient have been substituted. An investigation of the behaviour of a Coolidge tube by Professor J. A. Crowther, which appears in Part 1 of Vol. XXII. of the "Proceedings" of the Cambridge Philosophical Society, and which is referred to in *Nature*, affords some explanation of the failure of the two instruments to give a satisfactory account of the output of the tube. By means of an electrostatic oscillograph of his own design and a current oscillograph of the Duddell type, the electromotive force applied to the tube and the current through it were recorded on a falling photographic plate. On the same plate a narrow horizontal beam of the X-rays produced by the tube was allowed to fall, and in its path an aluminium wedge was placed, so that the intensity and quality of the beam could be estimated from the blackening of the plate. The resulting photographs show that it is possible to send current through a tube without exciting any X-rays, and that a Coolidge tube and an induction coil are an unsuitable combination.

IT is announced in the *Electrical Review* that a conference of telephone experts is to take place in Paris to discuss the question of the establishment of a European telephone network. Among the countries participating is Germany, whose geographical situation renders that country of great importance as a transit land for telephone communication. In discussing this problem at a recent meeting of the World Economic Association in Berlin, Herr Craemer is reported to have stated that there was no longer any difficulty in covering all distances in Europe, from the Spanish coast to the Polar Sea, by means of the telephone. It was necessary for the overhead lines to be converted to underground cables in order to render communication reliable. Cable networks were also in existence, in course of construction, or projected in other European countries than Germany, and all these networks were to be supplemented by overhead lines in districts where there was but little traffic, and were to be combined into an all-European telephone network. The total length of this cable network on first establishment would amount to 14,880 miles, of which over 25 per cent. would devolve upon Germany. The special object of the Paris Conference was to overcome the technical, organising and financial difficulties arising from the combination of the networks of the different countries into a general European telephone network.

Miscellanea.

THE Newcastle Watch Committee has decided to build a new fire and police station at a cost of £125,000.

THE Moss Bay steel works of the United Steel Company, at Workington, have re-started rolling rails.

A 200FT. vehicular ferry steamer built at Leith has recently started on the voyage of 13,000 miles to her destination, Sydney, New South Wales.

A COMPANY is being formed in this country for the development of a large iron and steel industry, based on the ore deposits of the Piernan River, Tasmania.

WORK will be started very shortly on the new Edinburgh–Glasgow road, which, it is estimated, will cost £1,865,000. The road will be 120ft. wide overall, with two 30ft. carriage ways, two 10ft. footpaths, and a space in the centre reserved for tramways.

ON April 28th King Victor Emmanuel opened the extensive hydro-electric works in the Tirso Valley which, it is claimed, are the biggest in the world. Besides providing electric current, the harnessing of the river will make possible the irrigation of an area of 100,000 acres of land.

THE Government of India has published the first, second and third reports of the Indian Tariff Board, relating to the grant of protection to the steel industry in India. Copies of the report are obtainable at the office of the Secretary to the High Commissioner for India, 42, Grosvenor-gardens, London, S.W. 1, on payment of a small charge.

UNDER an agreement between the Hearth Furniture Manufacturers' Association and the National Society of Brass and Metal Mechanics, an advance in wages of a penny an hour is to be given to all grades, the arrangement being similar to that arranged between the Brassfounders' Employers' Association and the same trade union.

BOTH imports into and exports from British India during February showed decreases in value, as compared with the preceding month. Exports, however, had established a record in January, and, with the February decline only a slight one, the balance of trade for the eleven completed months of the fiscal year was Rs. 64,00 lakhs, as compared with Rs. 21,40 lakhs in the corresponding period of 1922–23.

WORK has started again on the construction of the new Michigan Central Railway bridge at Niagara Falls, and it is now expected that the structure will be completed and in operation by the middle of November. The concrete spans leading from the shore lines on either side up to the bank of the river have been set. The most difficult work will be the setting of the approach girders on either side of the river. When the approach girders on the Canadian side are completed, the arch swinging over the river will be started.

FOR the first time in the history of the Chartered Institute of Patent Agents a meeting of members has been held outside London. This first provincial meeting took place on the 1st inst. at the Midland Hotel, Birmingham. A discussion took place on the question of the measure of protection at present afforded to patentees during the term of provisional protection, with the object of ascertaining the feeling of members regarding a possible amendment of the Patent Act to prevent infringement or piracy of an invention during the initial stages of its protection.

THE jury appointed by the Royal Institute of British Architects to award a medal to the architect who has designed the best street frontage completed during the year 1923 within a radius of four miles from Charing Cross, has just completed its task, and has given its award in favour of "The Shepherd's Bush Pavilion," designed by Mr. Frank Verity, F.R.I.B.A. The jury consists of:—The Earl of Crawford and Balcarres (chairman), Mr. J. Alfred Gotch, president of the Royal Institute of British Architects, Sir Edwin Lutyens, R.A., Mr. E. Guy Dawber, and Mr. Walter Tapper.

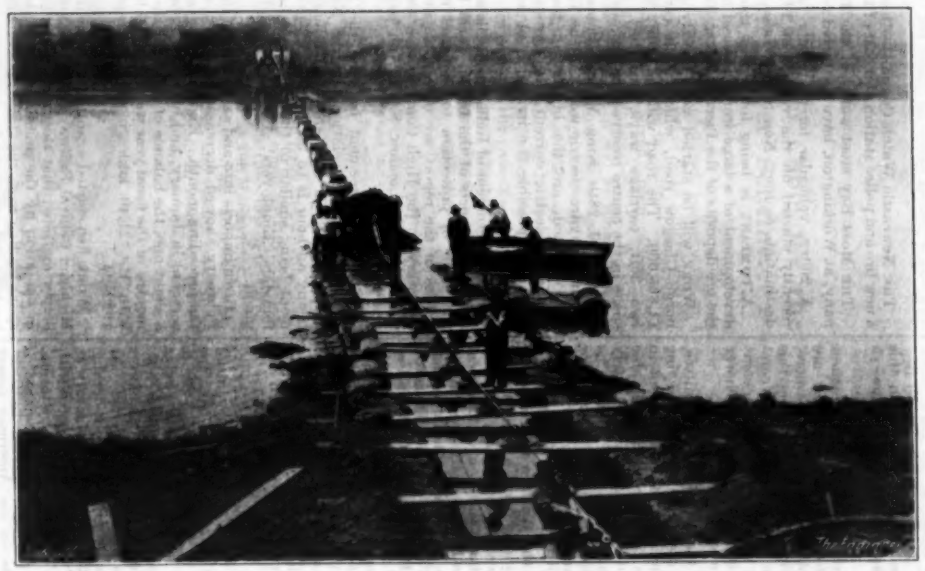
STATISTICS published by the Comité des Forges show that the number of blast-furnaces working on April 1st was 136, as compared with 134 on March 1st. During March the production of cast iron amounted to 634,567 tons, an increase of 44,227 tons compared with February. The March production of steel totalled 572,916 tons, an increase of 18,284 tons compared with the preceding month. Included in these totals are 245,561 tons of cast iron produced by Lorraine, compared with 230,779 tons in February and 191,074 tons of steel, compared with 193,307 tons in February. The results obtained are the most satisfactory recorded since the Armistice.

SPEAKING at a meeting of the Salt Union on the progress of the Mersey Power Company, an important subsidiary company, Mr. G. H. Cox announced that a contract for the supply of 10 to 20 million units of electricity to the London, Midland and Scottish Railway engineering works at Crewe was on the point of being concluded. The railway company, he said, had for some time been anxious to obtain the supply at the earliest moment, but difficulty had arisen through the fact that Crewe was included by the Electricity Commissioners in the North Wales Power Company's area. This was a purely arbitrary boundary, and the North Wales Company was not in a position to furnish any current at Crewe, whereas the Mersey Company's power was immediately available. This had presented an unnecessary obstacle to the prompt supply by the Mersey Company. Instead of supplying direct, the company had been obliged by the Electricity Commissioners to pass the current through the North Wales Power Company. The railway company had therefore been compelled to wait for the power it so urgently needed, and the Mersey Company had meanwhile been debarred from earning a large revenue. Apart from the important load to Crewe, a contract had been entered into to supply Northwich with a substantial amount of energy. As trade improved, he anticipated a full load for the power station. It had taken some years for electricity supply companies to come into their own, but nearly all of them were now paying good dividends.

LAYING A 22,000-VOLT THREE-CORE CABLE ACROSS THE WEST MELBOURNE COAL CANAL

(*For description see page* 508.)

END OF THE CABLE ABOUT HALFWAY ACROSS



END OF THE CABLE JUST REACHING THE SHORE

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THE CABLE PASSING FROM THE WATER TO THE ROLLERS

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DEATH.

On the 25th April, quite suddenly, at a nursing home, Bedford, J. S. MCNEILL, late Locomotive Superintendent, G.I.P. Railway, Bombay.

THE ENGINEER.

MAY 9, 1924.

The Marseillaise in Industry.

On May 1st the "Marseillaise" rang through the streets. Troop after troop of banner-led people with bands at their heads marched through our cities. They were there to let the world hear their protest against the outrageous principle that men should be rewarded according to the value of their services; against the doctrine that the individual has a right to liberty of action; against the ridiculous contention that one body of men is not justified in preventing another body from doing what it wills; and to assert, with brazen iteration, that no man ought ever to work so hard and so skilfully that he abases others less energetic or less able than himself. "Liberty" implies subordination to the will of those who claim that they represent democracy, "equality" means that labour is to be paid for at equal rates regardless of output, and "brotherhood" means that those who are most capable should at once lower their standard to that of the least capable, so that perfect equality may not be endangered. This is the democracy of the May Day procession; it is, as we have said, democracy of the most advanced kind. If it were universally supported, there would soon be an end of industrial Britain. Fortunately, it has many antagonists, even in the ranks of labour. Trade unions themselves repudiate it. Have we not seen, many times, one union of railwaymen asserting its superiority to another, and does not the Amalgamated Engineering Union protest against being classified with other engineering unions? No, these May Day demonstrations need not seriously disturb us. Like their bands, they are noisy, but, again like their bands, they are lacking in harmony. Yet in their crude way they express a doctrine which has always had many adherents, a doctrine which has to be fought against if industry is ever to recover, a doctrine which possibly must be destroyed if industry is again to find peace.

No doubt many of our readers have studied the three articles on "Peace in Industry," which Professor F. J. C. Hearnshaw has recently contributed to the *Morning Post*. Professor Hearnshaw is better known as a historian than as an industrial economist, but many will recall his "Democracy at the Crossways," which appeared in 1918. In the first two of the articles to which we have referred, he outlined the position; in the last he presented his "The Way of Peace." The first step he recommends is diligent educational enterprise to counter the spread of Marxian doctrines. The second is to humanise industry. He desires "that the honest and industrious workingman shall be given some adequate security in his toil, and some satisfactory guarantee against destitution in case of temporary unemployment." But whilst the industrious man is to be made secure, "it is imperative that the idler, the wastrel, the good-for-nothing should be rendered much less secure than he is at present. . . . The stringency of the poor law is essential if we are not to breed a pauper population which looks to support at the expense of the community as a right, divorced from all correlative duty. In short, security must be attained by the working-man as it is attained by the ordinary man of the middle class to-day, viz., by a system of insurance effected on business lines." The third step on "The Way of Peace" follows logically from the second. To be in a position to insure the workman must earn more than he can do under trade union restrictions. "Wages can come from one source only, viz., product. It is therefore essential that a workman should be paid according to the result of his work." The last step is "Friendly Partnership." Given good will and mutual understanding with augmented output, then improvement of industrial conditions would follow, and with improved conditions the troubles would come to an end. "If the conditions of industrial life are happy and natural, the demand for 'workers' control' in industry sinks into the obscurity from which it would never have emerged but for Syndicalist agitation." All this is very true, but it is very old. The same statements have been made time out of mind, and yet with no result. The conditions of industry have consistently improved, but there is as much agitation to-day as there was in the worst days of the industrial revolution, and, oddly enough, the very industries in which the greatest efforts have been made to improve the workers' lot do not escape the troubles. Compare the light, clean, well-ventilated and warmed engineering workshops of to-day with those of fifty years ago, compare the houses the men live in, the food they eat and the recreations that are open to them. Yet in engineering serious disturbances are frequent, whilst some other industries which remain very little better than they were two score years ago are never on strike. This aspect is not advanced as an argument against the improvement of working conditions. Even if it could be shown that strikes and labour disputes were the direct outcome of all that employers have done to make the lot of their workpeople more tolerable, we should still say, It is better to bear with the troubles than to see men and women living like dogs. The humanising of industry, the weeding out of the repulsive conditions which obtain to this day in some districts must continue, the dictates of humanity demand it; but do not let us flatter ourselves that Peace will follow from such labours. Professor Hearnshaw is, we believe, on sounder ground when he looks to the revival of individualism. In one of his earlier articles he discussed the effect of monotony of occupation and the persistent discipline which are essential elements of modern factory methods. We are inclined to agree with him that these things are responsible for much of the discontent. We have noticed the fact that the improvement of factories has not always diminished disputes; we must notice also that it is in these improved factories that we have also more advanced manufacturing methods, methods in which there is more routine, more monotony, more discipline. The least improved trades, those in which the conditions of work are worst, are those also in which there is least organisation, in which the workmen, however deplorable his working conditions may be, is to some extent his own master, in which he can vary his daily routine a little if he so desires, in which his reward is frequently in direct proportion to his own personal exertions, and in a smaller degree than in great works dependent on the general mechanism of a factory. This is a matter to ponder. But it is impossible to see any line of escape; it is impossible to see how our great industries can be carried on without modern methods.

We come back to the question of individuality. Two influences are at work making for its destruction. On the one hand, we have the modern manu-

facturing methods to which we have already referred, and on the other the influence of the unions. To surrender the methods is out of the question; rather, it would seem, must their application be increased. In no other way, save by an unthinkable lowering of wages or establishment charges, can we enter into competition with nations that employ them. But the individuality destroying influence of the trades unions could be removed. The written or unwritten law which seeks to check the endeavour of the more able and more energetic workman must be abrogated entirely. Liberty to do his best and to earn all he can should be allowed to every man. Then payment by results would become, wherever possible, the general practice, and the cost of production per piece would reach a lower point here even than in America, and unemployment and the sense of insecurity which it engenders would disappear. We cannot restore complete individuality, but we can at least give back that amount of it which is represented by the equality of reward with individual effort. In the course of time, we may even find means of going further. The effort for many years has been to make men and women into machines; to keep them at one job until they know it so well that they can perform it with astonishing facility and rapidity. There are always some individuals, particularly amongst women, who are content with that kind of life, who will go on day after day, year after year, feeding scraps of metal into a machine, scarcely knowing what the machine does to the metal and caring not at all what becomes of the part they have assisted the machine to make. That is not an exalted existence, but it is the kind of existence civilisation requires from certain people. With the increase of education, it will become more and more impossible, and a line of escape from it must be found, or we must gird ourselves to tolerate for ever the indefinite restlessness which it engenders and which results in the demand for shorter hours of work and more money to expend on recreations which become essential to the individual whose mind reacts against monotonous toil. Men who are interested in their work do not grumble at length of hours, and do not demand unreasonable rates of pay. "If," says Professor Hearnshaw, "the conditions of industrial life are happy and natural, the demand for 'workers' control' in industry sinks into obscurity. It is a big "if." We cannot honestly assert that the conditions, even after all practicable improvements have been made in our factories, are "happy and natural." In many respects they are a thousand times better than they were, but it remains true that for a large proportion—by no means all—factory life is dull and uninteresting and wholly without that element of naturalness that resides in the expression of one's own individuality.

At present, we have no cure for the ills that result from modern manufacturing methods, but the recognition that they do exist inspires the hope that some day a means of preventing or palliating them may be discovered. The desire to humanise industry is extending, and the improvements in the factories themselves, in the houses of the workpeople, and in the provision of recreation halls and grounds are all moves in the right direction. But, after all, they only serve to make tolerable the intolerable. Something more is wanted, or we must be content to go on paying wages which industry cannot afford in order to induce people to continue to do work which does not interest them, and there is only one economical way to do that; to pay by result. It has the double advantage that it gives the worker the money he desires and at the same time restores some measure of that individuality which is stultified by the false principles of May Day democracy.

Obituary.

KENNETH PHIPSON HAWKSLEY.

It is with regret that we have to announce the death of Mr. Kenneth Phipson Hawksley, which occurred on Friday, May 2nd, at his house, 60, Porchester-terrace, Bayswater, W. His loss will be keenly felt in engineering circles at Westminster, where the name of Hawksley has been a household word for more than seventy years. He worthily followed in the footsteps of his distinguished grandfather, Mr. Thomas Hawksley, F.R.S., and of his father, Mr. Charles Hawksley, both of whom became presidents of the Institution of Civil Engineers.

Kenneth Hawksley was born on September 15th, 1869, and was educated first at Wellington College and subsequently at Trinity College, Cambridge. After serving a pupilage with his father he became partner in the firm of T. and C. Hawksley in the year 1900. On the death of his father in 1917 he came rapidly to the front as one of the foremost experts in water engineering, and he was constantly in request to give evidence before Parliamentary Committees in connection with the schemes of corporations and companies. He had a very intimate knowledge of the principles relating to civil engineering, and with that knowledge was combined a great grasp of details and a most effective way of presenting a case before Parliamentary Committees. During the last few years there have been but few cases in which he was not engaged either on one side or the other.

In addition to his parliamentary work, Mr. Hawksley was the designing engineer for a great number of waterworks undertakings, and at the time of his death the works in hand comprised those for Bristol, Bognor, Newcastle-on-Tyne, Durham County Water Board, Maidenhead, Norwich, and many other places. Almost his last service before he was stricken by illness was to lay down the lines of a great impounding reservoir for the Durham County Water Board.

Mr. Hawksley held the position of consulting engineer to the following undertakings:—Sheffield Corporation Water, Norwich Corporation Water, Great Yarmouth Water Company, Lowestoft Water and Gas Company, West Gloucestershire Water Company, Herts and Essex Waterworks Company, Maidenhead Waterworks Company, Rickmansworth and Uxbridge Valley Water Company, and the Leatherhead and District Water Company.

During the war he rendered conspicuous service as consulting engineer for water supplies in connection with the Ministry of Munitions, and he laid out the water supply works at Gretna, Avonmouth, Queen's Ferry, and other large high explosive works.

Mr. Hawksley's activities were by no means confined to purely engineering matters; he was thoroughly at home on all questions of waterworks management, and at the time of his death was a director of the following undertakings:—South Essex Water Company, Tendring Hundred Water Company, West Gloucestershire Water Company, South Metropolitan Gas Company, Electric Lamp Factors, National Omnibus and Transport Company, and the Andalusia Water Company. His sound judgment and ready advice were much appreciated by his colleagues on these boards.

Mr. Hawksley was elected to the Council of the Institution of Civil Engineers in 1921. He was also a member of the Institution of Mechanical Engineers, the American Society of Civil Engineers, and many other scientific societies.

Literature.

Modern Gas Producers. By N. E. Rambush. London: Benn Brothers, Limited. 55s. net.

Mr. Rambush is to be congratulated upon his achievement in producing a comprehensive work upon gas producer practice from the British point of view. Consisting of nearly 550 pages and having over 350 figures and charts, its preparation must have occupied a considerable amount of time; but it is planned upon a simple framework, and the student will find in it none of that confusion and reiteration which all too frequently disfigures technical books of similar magnitude.

After a few remarks upon fuel utilisation and a brief historical statement, the author straightway launches upon his main subject. He divides it into four parts:—Theory; Plant; Working Producer Gas Plants; and Outline of Producer Gas Utilisation. The last two sections are somewhat disappointing, being extremely brief and incomplete; for example, Part III.—on the important subject of working producer gas plants—extends to but 15 pages out of 30, for the details of gas and coal analysis can scarcely be deemed germane to the subject of "working" but rather to "testing." Similarly Part IV.—the application of producer gas to industry—occupies less than a score of pages, and contains information of the character one expects to find only in a trade circular prepared for distribution to the general public at exhibitions.

It is, therefore, in the two earlier portions of the book that we look successfully for much valuable information of a practical kind, and fortunately the copious index—occupying as many pages as the "working" hints—will enable the earnest student to track down most of the things that matter. Engineers who have heard the author read various papers to professional Institutions, will need no reminder of his methodical presentation of a subject and can, therefore, realise that information upon a certain detail may be looked for in just that portion of the book which is the most likely to contain it. Indeed, the success of the author's work lies in the painstaking care with which each detail is treated, shaped and placed, so that the book, as a whole, excels other works upon the same subject.

We may pass over certain curiously worded phrases—such as "oxygen in the shape of air"—long sentences—as on page 59—involved statements—as on page 60—and the misplaced titles given to Figs. 11 and 12, as these will no doubt be corrected in a later edition. But we look in vain for mention amongst modern by-product recovery producers of the pre-distillation retort, for which Mr. T. Roland Wollaston, of Manchester, is responsible, and which has been the subject of a notice in our columns. It is to be noticed also that the description and illustration of the Dowson double-zone bituminous suction producer gas plant is out of date in that no mention is made of the supersession of the external gas belt by an internal inverted U-channel, which forms a striking advance in design reducing operating difficulties and making for constancy of gas quality. Similarly the water bottom shown in the illustration has now been superseded by a grate with shaking bars. Another modern development that Mr. Rambush does not speak about when dealing with "edge burning" of fuels—that is, the quicker combustion of coal against the walls of the producer owing to greater air velocities occurring there—is that it has now been largely reduced by the provision of a central gas outlet and deeper fuel beds. This omission is remarkable, seeing that the author himself has—as noted on page 294—been engaged in converting some of the earlier forms of producers from a central fuel inlet to a central gas outlet, with extremely satisfactory results. Perhaps this is one of the "special devices" there referred to.

Mr. Rambush mentions that there is a great amount of research work yet to be attempted under industrial conditions, and to this statement there will be general agreement. Unfortunately the normal working load variations, coal difficulties, and shift working do not entail the stable conditions necessary for scientific investigation to extend over a sufficiently lengthy period to obtain conclusive results. Hence, we fear it will be long before we are able to realise why, of two identical plants erected in different factories, not necessarily far apart, one will give far less trouble than the other. Probably it is this lack of industrial research work which is responsible for the impression that the author himself appears to be more at home in the technical drawing-office and laboratory than in factories; or is it the reviewer's disappointment at the meagre contents of the portion devoted to producer gas plant operation and producer gas applications that is really responsible for that impression?

BOOKS RECEIVED.

Gemeinfassliche Darstellung des Eisenhüttenwesens. Düsseldorf: Stahleisen M.b.h., Ludendorffstrasse, 27.

Royal Automobile Club Year Book, 1924. London: The Royal Automobile Club, Pall Mall, S.W. 1. Price 4s. net.

Payment by Results. By J. E. Powell. London: Longmans, Green and Co., 39, Paternoster-row, E.C. 4. Price 21s. net.

Road Engineering. By E. L. Leeming. London: Constable and Co., Limited, 10–12, Orange-street, W.C. 2. Price 18s. net.

The Modern Theory and Practice of Pumping. By Norman Swindin. London: Ernest Benn, Limited, 8, Bouverie-street, E.C. 4. Price 42s. net.

Chemistry of the Rarer Elements. By B. Smith Hopkins. London: G. C. Harrap and Co., Limited, 39–41, Parker-street, Kingsway, W.C. 2. Price 15s. net.

Les Combustibles Liquides et le Problème du Carburant National. By M. Aubert. Paris: Gauthier-Villars et Cie., 55, Quai des Grands-Augustins. Price 24f.

Industrial Management. By Richard H. Lansburgh. London: Chapman and Hall, Limited, 11, Henrietta-street, Covent Garden, W.C. 2. Price 22s. 6d. net.

The Strength of Dished Ends. By C. C. Pounder. London: Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's-square, S.W. 1. Price 2s. net.

Structural Engineering. By Joseph Husband and William Harby. London: Longmans, Green and Co., Limited, 39, Paternoster-row, E.C. 4. Price 16s. net.

Drying by Means of Air and Steam. By E. Hausbrand. Third revised English edition. London: Scott, Greenwood and Son, 8, Broadway, Ludgate, E.C. 4. Price 6s. net.

Reports of the Progress of Applied Chemistry. Issued by the Society of Chemical Industry. Vol. VIII., 1923. London: Society of Chemical Industry, Central House, Finsbury-square, E.C. 2.

Emergency Water Supplies for Military, Agricultural and Colonial Purposes. By A. Beeby Thompson. London: Crosby Lockwood and Son, Stationers' Hall-court, Ludgate-hill, E.C. 4. Price 21s. net.

Annales des Ponts et Chaussées; Partie Administrative. Fasc. I., 1924.—I. Janvier-Février; *Partie Technique,* Fasc. I., Tome I., 1924.—I. Janvier-Février. Paris: A. Dumas, 6, Rue de la Chaussée-d'Antin.

Guide to Rhodesia, for the Use of Tourists and Settlers. With illustrations, maps and plans. Second and revised edition. London: Beira and Mashonaland and Rhodesia Railways, 2, London Wall-buildings, E.C. 2. Price 2s. 6d. net.

Praktisches Maschinenzeichnen mit Einführung in die Maschinenlehre. I.: Das Maschinenzeichnen Zeichnen nach Vorlage und Zeichnen nach Modell. II.: Die wichtigsten Maschinenteile in zeichnerischer und Konstruktiver Hinsicht. By Richard Schiffner. Berlin: Walter de Gruyter and Co., 38, Genthiner-strasse.

The Resources of the Empire Series. Under the general editorship of the Federation of British Industries. (1) *Fuel.* By G. W. Andrew. (2) *Ferrous Metals.* By M. S. Birkett. (3) *Non-Ferrous Metals and other Minerals.* By N. M. Penzer. (4) *Communications.* By W. Tetley Stephenson. London: Ernest Benn, Limited, 8, Bouverie-street, E.C. 4. Price 21s. net each volume.

Iron and Steel Institute.

PRESIDENTIAL ADDRESS BY SIR WILLIAM ELLIS, G.B.E., D. Eng.

IN considering a suitable subject for my address, I felt that it was better not to deal with any technical subject in detail, as these matters come before us so fully in the various papers which our members bring forward at the meetings; but in view of continuous work for nearly forty years in one of the leading steel works dealing with specially complicated metallurgical problems, I thought it would be of interest—possibly of value also—to compare the position of such a steel works at the time I commenced work of this nature with the state of things which exists to-day, and to point out what, in my opinion, are the circumstances which have enabled this very great change and development to take place.

In the early 'eighties the management of steel works was in the hands of men of great common sense and great power of application, but owing to the absence of efficient means of training they were unable to deal with their practical difficulties except by common-sense methods. Boiler pressure, for instance, was rarely more than 50 lb.; in fact, there was a prejudice against higher pressures, owing to the presumed danger arising therefrom. The steel works engineer in those days was not even willing to admit that a boiler suitably designed for 150 lb. pressure was no more dangerous than one with only 50 lb. pressure. The various departments were run by separate engines with long steam mains, very often ill protected against condensation, so that the efficiency of the various driving engines was very low. Hydraulic pressure of 400 lb., sometimes 750 lb., was largely in use, but likewise produced by very uneconomical engines. Steam hammers up to 50 tons were in use, but four firms had already put down forging presses up to 4000 tons, and steel shafting for marine work was only just being introduced. Jib cranes, which were very slow in working and uneconomical, were largely in use in the forges, and the overhead crane was only beginning to be adopted. These were often driven by long lines of square shafting from small engines uneconomically served by low pressure steam from a distant boiler, or in the case of machine shops by ropes similarly driven. The Bessemer process was in full swing, and the Siemens-Martin furnace was already being largely developed, but a 30-ton furnace was in those days regarded as a large one. The mills, which were of relatively small horse-power, were still driven with beam engines and gear, and the direct rolling of steel rails from ingots instead of from cogged blooms had not long been introduced. Large numbers of men were employed in the mills, and mechanical means for charging the ingots or blooms and for manipulation during rolling were not yet in use, except to a very limited extent. Dr. Sorby had already made his microscopic experiments on the structure of steel, but his original idea had hardly been made practical use of. Metallurgy as a science could hardly be said to exist, and technical institutions for the training of many students in engineering and metallurgy were only then coming into existence. I must offer my thanks to Leeds University, then the Yorkshire College—where I was a student—for the excellent opportunities of technical training afforded by that institution, even in those early days. The few young men of more advanced technical training were not regarded with favour, and some of them with such training who had not also practical training alongside of it were no doubt somewhat of a danger. They brought with them knowledge of a description which could not be absorbed, and was not generally respected, by the then type of steel works manager, and the young man with such training was no doubt in many cases somewhat impatient and impetuous, feeling in his youthful vigour that progress was not fast enough for him. I cannot help feeling that great credit should be given to the men of those days, who with their poor technical equipment were able to do the good work they did, and developed the industry of the country as satisfactorily as was the case. It must be borne in mind, however, that at that time there was a great demand for all kinds of railway material, and marine engineering was developing at a great rate, calling for steel forgings and castings of a very complicated nature, and there was therefore not the same element of keen competition as at the present time. The cost of production was not of the same importance as it is to-day, and the specifications, owing to the class of steel which it was then possible to manufacture, were of a totally different nature to those we have with us now.

I would say therefore without any hesitation that, creditable as was the result of the efforts of such men in those early days, they could not possibly succeed with the limited qualifications they possessed under modern conditions.

Let me now turn to the picture of a modern steel works. It is difficult to realise how so great a change has been brought about. The Bessemer process has practically disappeared in this country, and the Siemens-Martin process reigns supreme, but on a much larger scale, furnaces up to 60 tons weight being common practice. Steel making in electric furnaces has also been introduced, and, owing to the absence of coke in the process, steel of exceptional purity is being produced, and a very accurate analysis is obtainable owing to complete control during melting being possible.

Forging plant has developed to a very great extent. Hammers for anything but light purposes have disappeared, and quick-acting forging presses have been universally adopted. Pumping engines for these presses have largely given place to the use of intensifiers, which have proved their worth, both in cheap maintenance and economic use of steam. The demand for heavy gun tubes which have to be hollow forged on a mandrel, and of alloy steel, calls for one of the highest classes of forging yet undertaken, uniformity of heating prior to the forging operations and in the subsequent annealing being essential in order to obtain the difficult physical properties required. Ingots of over 100 tons in weight are required, both for gun forgings and for large marine shafting, and it is obvious that it is only the introduction of hydraulic presses for forging purposes which has rendered this class of production possible. The use of lighter presses, 2000, 1000 and 500 tons, for varying classes of forging work, has also become common practice, and steam hammers have practically disappeared except for use in the smiths' shop and for the production of lighter classes of forgings.

The introduction of electric driving and high-pressure steam are the two elements which have, to my mind, revolutionised steel works equipment and introduced economies more than any other features, except perhaps improved education. I remember the late Sir William White seeing our first small sets of electric power engines and prophesying that in a short time every machine in the works would be driven thereby and every steam engine abandoned except for electric power generation. These small sets have long since been replaced by large central stations supplying practically the whole power for the different departments in the steel works. Mill engines of 12,000 horse-power with steam at 150 lb. pressure have been installed for driving mills producing enormous daily tonnage. Electric cranes up to 200 tons lifting power have taken the place of older cranes driven by either ropes or square shafting. Of the various machines many of them are driven by separate motors, in exceptional cases exceeding 100 horse-power on single machines. In the old days no machine tool-maker, so far as I know, had a more accurate gauge of the power required for driving different types of machines than the information arrived at from the belt of a certain width. The introduction of electricity has made it possible to arrive exactly at the cost of power in each department in a steel works, thereby enabling the management to trace the lack of economy in different directions.

Hydraulic power for crane purposes in a steel works received a set-back by the introduction of electricity as, for reasons which are well known, it is less economical in service.

The management of the different departments is now in the hands of men of high general education and special technical education either as engineers or metallurgists. Metallurgy as a science has practically been born since the earlier years I speak of. Definite training courses have been established in most of the industrial steel centres, in some cases carrying degrees as high as that of doctor. It is, in my opinion, mainly due to the great advance in technical education and the recognition on all sides of its importance which has enabled the great development and improvement in the steel industry in recent years to take place. Most of the men I speak of have large practical experience in a steel works in dealing with the difficult problems which present themselves, and are able to combine the application of their technical training with consideration of these problems, an advantage not possible in early days.

Metallurgy is, I feel, a science still in its infancy, or possibly in early manhood. There are obviously before the leading metallurgists of the country great unsolved problems which it will take years to work out, but it is each year becoming on a sounder basis. The National Physical Laboratory has been established, and is doing good work in research, which is available to a great extent for the industry at large.

In the early days I speak of, chemical laboratories only existed at some of the most important steel works. To-day no works of any importance is without a thoroughly well-equipped chemical laboratory in charge of a chief chemist of high training. In addition to this several of the large establishments have their own research laboratory in charge of a distinguished metallurgist, to whom problems of special difficulty are referred for consideration.

The changes I have spoken about in management and machinery are of such a drastic nature that nothing but a revolution in the type of training and education could have made them possible, and those who in early days were inclined to shut their eyes to the advantage of the advancement of scientific education and scientific methods in dealing with our great industry would to-day, were they with us, be bound to admit that it is only the great developments in these directions which have made possible the huge advancements in the steel industry that so many of us have watched with such interest. As these improvements have taken place the demands for higher quality which were thereby rendered possible have come on to the steel makers, and are, I think, being reasonably met. Specifications to-day for all kinds of railway work are all of a very high order, especially in this country, and the requirements are being complied with. Specifications for gun forgings, armour plates, aeroplane material, &c., are of an exceptionally difficult nature, and have been a great tax on the leading steel makers of the country. Alloy steels of a varied nature for meeting different requirements have come into existence and are being produced with an extraordinary measure of accuracy, giving results with varied heat treatments which enable important machinery to be built of a very much lighter nature. Stainless and rustless steels have now been introduced and are proving of great value to the varied cutlery interests and in other directions, and if it be possible to develop the latter class of steel for heavier material, such as is used in under-sea construction, it will enormously increase the life of such structures.

The great advances in technical education and metallurgical knowledge which I have referred to have naturally not been without effect on the papers which come before this Institute for reading and discussion, and several of my colleagues on the Council are inclined to regret that so many of the papers put before us are of too technical a nature and do not deal sufficiently with actual works problems and the difficulties arising therefrom.

We are naturally anxious that the scientific aspect of metallurgy as applied to steel making should find its proper place in our discussions; but I would urge the generous consideration, on the part of heads of firms, to afford all reasonable opportunities to members of their staff to prepare and read before this Insitute papers dealing with the practical difficulties encountered during the different processes of manufacture. I do not, for a moment, urge that matters of a confidential nature affecting the interests of a firm should be publicly discussed, but there are still many problems of general interest to steel makers with which our various members have a large experience, that, without any damage to the interests of a particular firm, could be usefully discussed at our Institute, and would result in a general benefit to the industry.

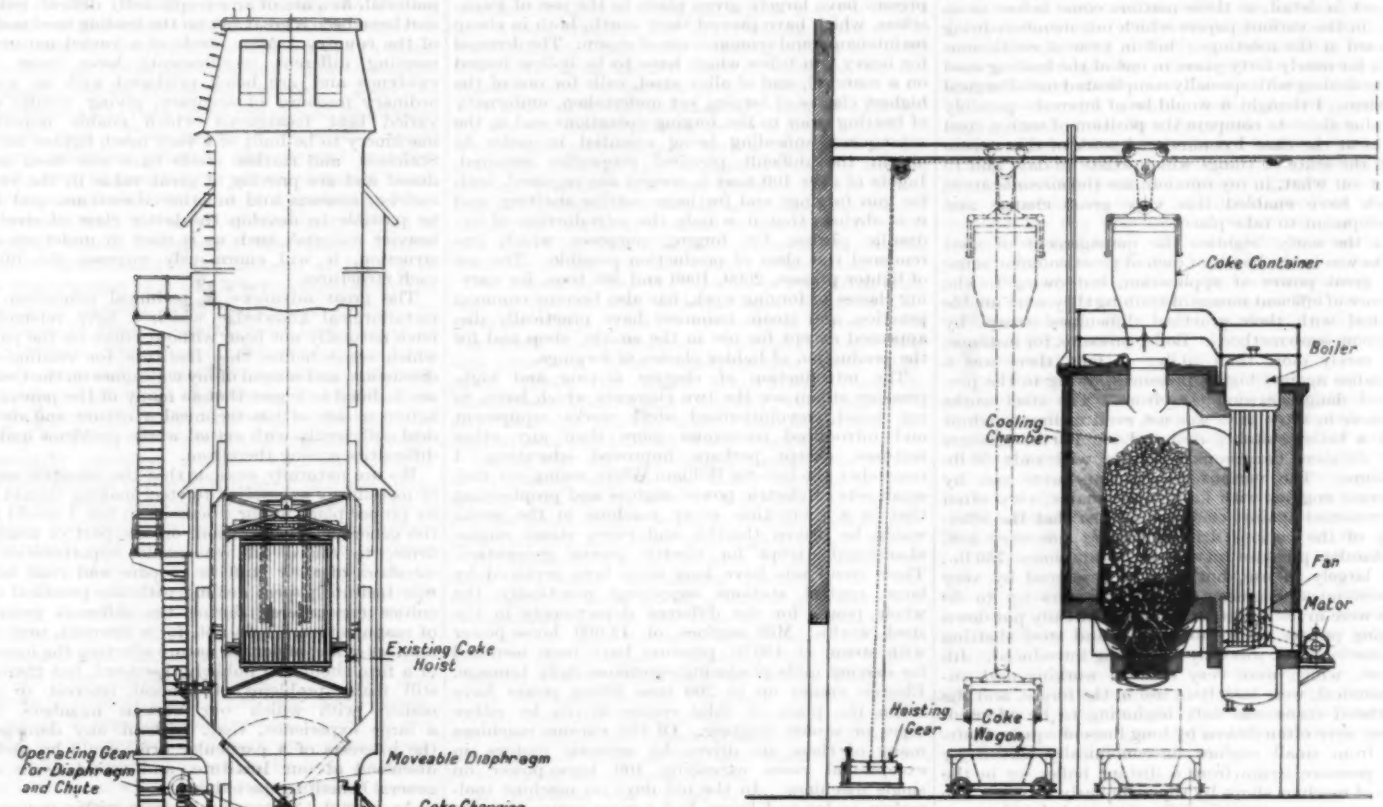
As I want to keep my address within reasonable limits, I can only touch on one or two matters of importance and interest of a manufacturing nature. Although great progress has been made in the manufacture of ingots of heavy tonnage—I allude to ingots of from 20 to 100 tons—since the days when they were made in composition moulds, there is yet a great deal to do before uniformly satisfactory ingots can be produced. In this problem we are obviously up against certain natural laws, and it is the conquest of these natural laws which constitutes in a great measure the difficulty which exists. It may be assumed that the quality of the steel as it leaves the furnace is what is required, and that the melting has been satisfactorily carried out and the requisite analysis arrived at. The troubles which exist arise mainly from the behaviour of the steel after it is run into the mould. The greater the diameter of the ingot the longer is the time of cooling, and consequently the greater is the difference in structure between the top and bottom and the outside and centre of the ingot. The Whitworth fluid pressing system introduced many years ago, the use of cast iron moulds instead of compo-lined, the introduction of the Harmet process, were all endeavours to overcome the effect of the natural rate of cooling, and were attempts to arrest the steel in its uniform quality when it arrived in the mould. Owing to the difference in specific gravity of the different elements in a steel ingot, principally carbon, sulphur, and phosphorus, the longer fluidity continues the greater is the opportunity for these elements to rearrange themselves to their own liking. This results in segregation and various occlusions, and in view of the nature of the work for which ingots of this sort are required as great a uniformity in structure and physical properties as possible is essential. The metallurgist who can successfully overcome the inherent difficulties of producing ingots of large weight and uniform structure will have indeed done a great service to the steel industry.

One development of a special nature which it was my privilege to be associated with is of sufficient interest for me to allude to. When my firm was entrusted with the building of the Carmania and then the Lusitania, both turbine driven, the manufacture of the turbine drums constituted a mechanical difficulty, which was dealt with by welding the drums. It was obviously desirable, however, to introduce some better method. I was fortunate in seeing at the Düsseldorf Exhibition the development on a very small scale of a hollow rolling process. We obtained the patent rights for this and designed in association with the patentees a much larger rolling mill and also a powerful punching press, which enabled us to commence with a solid ingot from which the centre was punched or, in the case of larger work, bored. Thereafter it was rolled to the requisite diameter in the hollow rolling mill. On the introduction of geared turbines this method was again of special use, as most of the large gear rims for the different war vessels

DRY COKE-COOLING PLANT AT KEILEHAVEN GASWORKS, ROTTERDAM

SULZER BROTHERS, WINTERTHUR, ENGINEERS

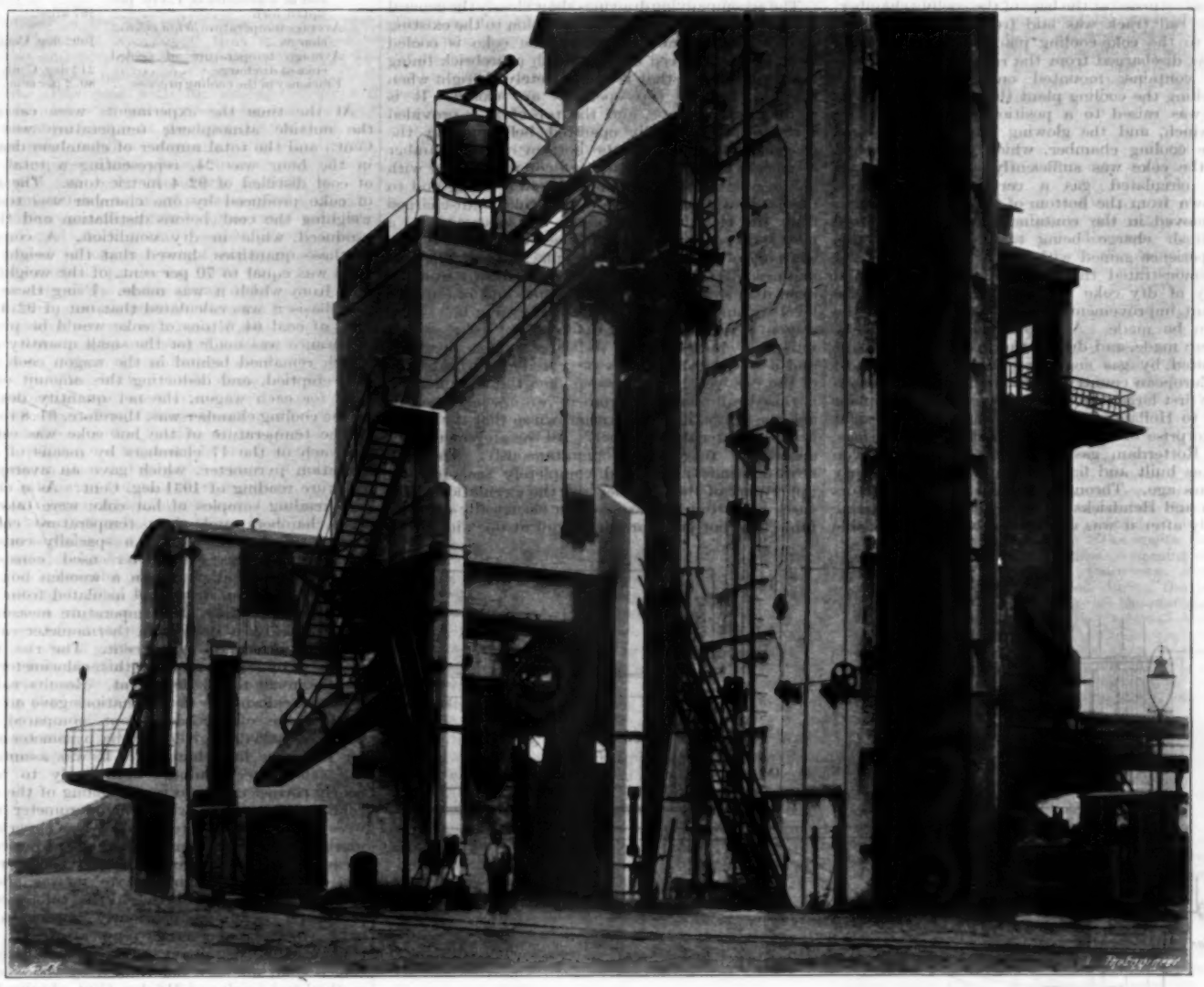
(For description see opposite page.)



Arrangement of the Experimental Plant at Schlieren.

DRY COKE-COOLING PLANT AT ROTTERDAM

SULZER BROTHERS, WINTERTHUR, ENGINEERS



and passenger lines have been made in this way. It is felt that a greater uniformity of structure is obtained over the periphery where the teeth have to be diagonally cut in rims produced by hollow rolling. My reason for mentioning this particular industry is that I feel for many purposes development in the way of producing hollow ingots would be of great service, as it would to a great extent do away with the undesirable centre portion of the ingots of large diameter which has now to be removed by punching or boring. It is also not impossible that for plates of large sizes, where special uniformity of quality is necessary, a hollow ingot cut and flattened out might give better results than if rolled from a solid ingot of heavy tonnage. Consideration, I know, is being given to this question, and I hope successful results may be obtained.

Problems of considerable difficulty are being met with by steel makers throughout the country, especially those engaged in the forging industry, owing to the great development which has taken place in electric power stations. Rotor forgings of great magnitude and carrying a big load at high velocities are required, and I venture to urge the great importance of the engineer and the metallurgist or steel maker conferring together on their design. The steel maker must be able to understand the importance to the engineer of rotors of a certain design, and it is equally important that the engineer must be able to grasp not only what the difficulties of the steel makers are in producing the article in question, but the fact that unless there is some modification in his requirements, such as will enable the steel maker to produce absolutely reliable forgings, trouble may arise in the unsatisfactory working of such machines. This is one of the many instances which makes me feel that the close co-operation between the engineer and the metallurgist is absolutely necessary for the satisfactory development of the steel trade. The more they sympathise and understand each other's requirements and difficulties, the greater will be the success of their results. Engineering as a science has been in existence much longer than metallurgy, and is therefore on a more finite basis; but metallurgy, although making great strides, has not yet reached full manhood, and tolerance on the part of the engineer and realisation of the metallurgists' difficulties are essential for obtaining good results.

I cannot conclude my address without a slight allusion to the valuable work introduced by Sir John Wolfe Barry in the founding of the British Engineering Standards Association, now so ably continued by Sir Archibald Denny, the present chairman, and the many distinguished men in the country who are assisting him, and to whom our thanks are due. Variety of design in all classes of machinery and variety of physical tests in the different parts, has cost this country very dearly, and the valuable work which this Association is doing cannot fail to be of the greatest service to the steel makers throughout the country, not only in lessening the varied nature of their productions, but by thereby introducing economies which will enable us to compete with our powerful overseas neighbours.

The steel trade of this country is passing through a very anxious and critical period, with competition from other countries of a nature far more acute than we have ever previously encountered. We require all the help which standardisation, technical training, and scientific development can give us, in addition to close application to duty on the part of all of us to enable our country to maintain her eminent position in the steel world, and thereby afford occupations to the many thousands of men who rely on the steel industry for their livelihood.

The Dry Cooling of Coke.

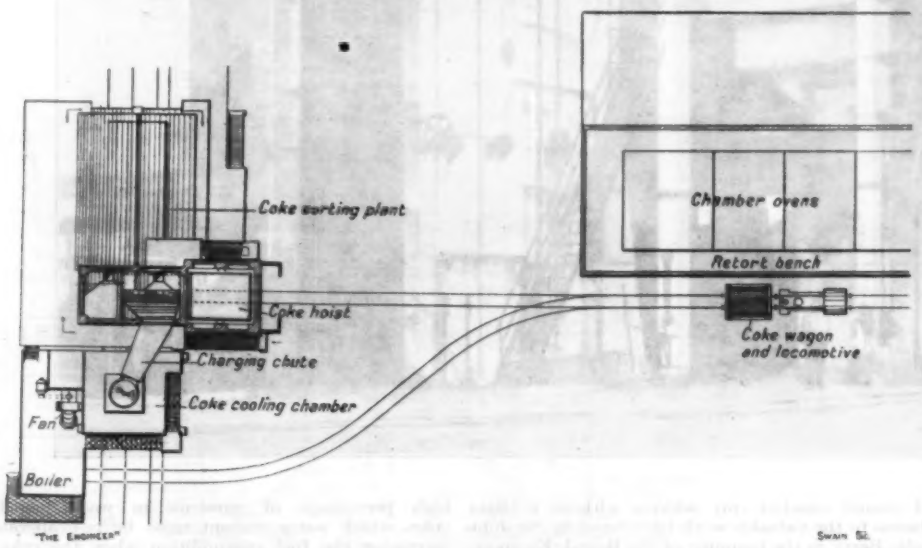
THERE are few more striking examples of heat waste than that which is afforded when a mass of glowing coke is quenched by water. Any engineer seeing a wagon of hot coke immersed in water, or coke freshly drawn from the oven sprayed with water, cannot fail to mark the wasteful character of the process and the many drawbacks which are associated with it. Not only is the heat of the glowing coke entirely lost, but the sudden quenching with water splits and disintegrates the cell structure of the coke mass, lessening the amount of valuable large coke produced, and greatly adding to the less useful small coke and dust. From the point of view of the coke user another disadvantage is the presence of a high percentage of moisture in water-quenched coke, which water content must be re-evaporated, increasing the fuel consumption when the coke is later used for heating purposes. Again, from the point of view of the gasworks engineer, the wet cooling system is likely to create difficult problems of plant management. When large quantities of coke are to be dealt with continuously a considerable amount of water is required. This necessitates pumping plant with distributing mains, stand pipes and hoses, while cooling beds of adequate area with drainage systems must be provided. In winter heavy frosts and burst pipes may bring about interruptions in working, causing an accumulation of uncooled coke, and thus interfering with its regular treatment and removal which is so necessary for good working. An additional disadvantage of the wet quenching process is the marked deterioration of the structure of the retort house, and the heavy wear and tear on all metal parts, including the conveyors, which is directly caused by the sulphuric acid present in the vapours produced by water quenching.

THE PRINCIPLE OF DRY COOLING.

In the dry cooling process the glowing coke is enclosed in an air-tight chamber and an inert gas circulated through it. In practice it does not become necessary to supply this gas, as the air in the coke containing chamber gives up nearly all its oxygen when it passes through the coke for the first time, leaving an inert gas—mainly nitrogen—in the chamber. The gas is circulated by a specially designed fan through boiler tubes, and transfers the heat in the coke to the water in the boiler, raising steam. By this means the temperature of the coke is reduced from about 2000 deg. Fah. to 400 deg. Fah., and steam may be raised in the boiler at any desired pressure, or large quantities of hot water produced.

The first experiments with this new system of cooling were carried out by Sulzer Bros. at Winterthur during the war period, and by the year 1919 the results which were obtained were so satisfactory that a larger test plant was constructed at the Schlieren gasworks near Zurich. The general arrangement of this plant is shown diagrammatically in the illustration reproduced on the right of page 514.

It will be seen that a cooling chamber of circular shape was employed, which was placed in communication with the vertical tubes of a boiler built alongside the cooling chamber. The heated gas was drawn from the space above the glowing coke by a small motor driven fan, and after giving up its heat to the boiler was returned at the base of the cooling chamber. A single rail track was laid from the vertical gas retorts to the coke-cooling plant, and the glowing coke was discharged from the retort into a bucket-shaped container mounted on an undercarriage. On reaching the cooling plant the container with its charge was raised to a position above the cooler by a winch, and the glowing contents discharged into the cooling chamber, which was then sealed. When the coke was sufficiently cooled by means of the circulated gas a certain quantity was withdrawn from the bottom of the cooling chamber and removed in the container previously referred to, a fresh charge being taken in at the top. The experience gained with the Schlieren plant not only demonstrated the extreme practicability and economy of dry coke cooling, but enabled several important improvements in the construction of the plant to be made. A large number of efficiency tests were made, and during the first years the plant was visited by gas engineers of note from almost every European country. The distinction of possessing the first large commercial dry coke cooling plant belongs to Holland, for it was through the foresight and enterprise of Directors Sissingh and Hendricks, of the Rotterdam gasworks, that the Keilehaven plant was built and first put into operation nearly two years ago. Through the courtesy of Directors Sissingh and Hendricks we were enabled to examine it shortly after it was erected, and we are now able



PLAN OF CHAMBER OVENS AND COKE-COOLING PLANT

to give some authentic figures as to its working, and also some results of the experiments which have been made with the plant.

THE KEILEHAVEN PLANT.

The coal distilling plant at the Keilehaven works of the Rotterdam Gas Company consists of a battery of ten chamber ovens, each of which is provided with four chambers having a coal capacity of approximately 4½ tons each.

In normal operation only eight ovens are in use. The period of distillation is 24 hours for each charge, so that during this time it is necessary to discharge and deal with the hot coke from 32 chambers, an amount weighing in total well over 100 tons. The hours worked are from 6 o'clock in the morning until 10 o'clock in the evening, after which time the chamber ovens are left in charge of one attendant who refills the gas generators and gives general oversight. No coke is drawn, however, during the night period. A plan of the retort house is given above, and a general view of both the old and the new coke-cooling plants is shown by the engravings and drawings reproduced on pages 514 and 515. It will be noticed that a single rail track is run alongside the retort bench and connects with both the cooling plants. Before the dry coke cooling system was adopted the general procedure for cooling the coke was as follows. After the glowing contents of an oven chamber were discharged into a wagon, this was transported by a small locomotive to the coke hoist—shown on page 514. The wagon, with its contents, was then lowered into a water-filled chamber, and the steam and gases so formed were allowed to escape up the tall ventilating shaft provided. When cooling was sufficiently advanced the wagon was raised in the hoist to the level of the coke-sorting plant and its contents delivered to the sorting floor by means of an inclined chute. The introduction of the new system demanded some alterations and additions to the existing plant, but the design was carried out in such a manner that the working of the old plant was not interfered with. Thus the original hoisting gear was retained and arrangements made to charge the new apparatus with hot coke and deliver the cooled coke to the sorting floors by means of the same lifting gear with a moveable diaphragm built into the ventilating shaft.

The accompanying drawings show clearly the general design of the new plant and its relation to the existing plant. The chamber in which the coke is cooled is built of reinforced concrete with a firebrick lining in such a manner that it is completely air-tight when the bottom and top openings are closed. It is rectangular in shape, and the top of it is provided with an automatically operated bell covering the charging aperture. At the bottom of the chamber a specially shaped discharging door is arranged with guiding bars to keep the mass from sticking and to regulate its descent. The actual coke is discharged from the chamber by a chain bed operated by a motor driven worm gear. The charging and discharging of the chamber takes place in the following manner. When a charge has been drawn from an oven it is shunted to the coke hoist and raised to a level within the shaft above the charging bell. The wagon is now tipped so that the hot coke is shot into the chute leading to the charging aperture, and a telescopic chute is projected into the mouth of the receiver. At the same time the charging bell is raised automatically from its water-sealed seating and the protecting slide withdrawn so that the charge is free to enter the chamber. All the aforementioned operations take place simultaneously. The bell now descends again and completely seals off the upper part of the chamber and the circulation of the gases is started by means of an electrically-operated fan. The hot gases are drawn off at one side of the upper part of the chamber, and after passing through the smoke tubes of the boiler, consisting of an upper and a lower drum, they are returned underneath the coke charge at the bottom of the chamber and rise through the coke mass to the top of the receiver, a closed cycle thus being formed. Special care has been taken in the design of the fan and the variable speed motor driving it, and by regulating the motor speed a very fine control of the volume of gas circulated and the amount of steam raised is obtained.

We were permitted to examine the plant shortly after it was placed in operation, and everything worked in a very satisfactory manner. Some modifications have since been made in the water-circulating system of the boiler, and also to the hoisting gear belonging to the already existing plant, which, we understand, have facilitated very smooth and successful working.

The two men originally employed for the wet-cooling process suffice to drive the shunting locomotive, to operate the charging and discharging gear, and to check from time to time the amount of coke in the chamber by an outside indicator specially provided for this purpose. Two shifts are worked, so that two pairs of men attend the plant during each 24-hour period.

EXPERIMENTAL RESULTS.

It may be of interest to our readers to give particulars of certain results which have been obtained at Keilehaven by means of experiments made with a view to testing the efficiency of the plant. We are permitted to publish these results through the courtesy of Director Sissingh of Rotterdam, under whose direction the work was carried out. The experiments consisted of a series of observations made each during a 24-hour period, which comprised 16 hours in which the chamber ovens were discharged one after the other and cooled in the plant, and 8 hours in which the coke remaining on the plant was further cooled until the beginning of the next working shift. The figures which follow show in a summarised form the results which were obtained.

Cooling capacity of plant per hour	6 tons of coke
Boiler pressure .. .. 10 atm.,	145 lb. per sq. in.
Feed water temperature	57 deg. Cent.
Steam raised per ton of coke cooled and at a pressure of 124 lb. per square inch	467 kilos.
Average temperature of hot coke at charge	1092 deg. Cent.
Average temperature of cooled coke at discharge	212 deg. Cent.
Efficiency of the cooling process ..	80.2 per cent.

At the time the experiments were carried out the outside atmospheric temperature was 4 deg. Cent., and the total number of chambers dealt with in the hour was 24, representing a total weight of coal distilled of 92.4 metric tons. The amount of coke produced by one chamber was tested by weighing the coal before distillation and the coke produced, while in dry condition. A comparison of these quantities showed that the weight of the coke was equal to 70 per cent. of the weight of the coal from which it was made. Using these figures as a basis it was calculated that out of 92.4 metric tons of coal 64.6 tons of coke would be produced. Allowance was made for the small quantity of coke which remained behind in the wagon each time it was emptied, and deducting this amount of 0.117 tons for each wagon, the net quantity dealt with in the cooling chamber was, therefore, 61.8 tons.

The temperature of the hot coke was estimated for each of the 17 chambers by means of a Hase radiation pyrometer, which gave an average temperature reading of 1031 deg. Cent. As a check on this reading samples of hot coke were taken from five chambers and their temperature calculated from readings obtained in a specially constructed calorimeter. The calorimeter used consisted of a cast iron vessel placed in a wooden box 50 cm. square by 75 cm. deep, and insulated from it by a layer of slag wool. All temperature measurements were made by a Beckmann thermometer calibrated to read correct to 1 per cent. The rise in temperature of the water in this calorimeter jacket was from 20 to 23 deg. Cent. Results calculated from the calorimeter determinations gave an average temperature of 1087 deg. Cent. compared with a value of 1026 deg. given by the pyrometer readings for the same five chambers. It was assumed that the calorimeter readings were likely to be more nearly correct owing to rapid cooling of the exposed coke surfaces, from which the pyrometer readings were taken. In order to make an even closer approximation to the actual temperature of the hot coke, the mean pyrometer figure for the 17 chambers—1031 deg. Cent.—was taken, and to it was added the difference of 61 deg. between the calorimeter and pyrometer readings previously mentioned. This gave a calculated average temperature for the hot coke of 1092 deg. Cent. The temperature of the cooled coke was also determined by the calorimeter method and a value of 212 deg. Cent. obtained.

For the calculation of the heat which can be recovered from the hot coke, the figures for the specific heat of coke—Terres and Schalter in *Gas and Wasserfach*, 1922, page 831—were taken as under:—

Average specific heat between 1092 deg. and 21 deg.	0.365
Average specific heat between 212 deg. and 21 deg.	0.202

The cooling of 61.8 tons of hot coke from 1092 deg. Cent. to 212 deg. Cent. releases heat to the extent of 61.8×10^3 $(1092 \times 0.365 - 212 \times 0.202) = 21{,}770 \times 10^3$ Cal. or per ton of coke 352×10^3 Cal. The evaporation in the steam boiler during the same 16-hour period was 28.81 cubic metres the steam having a pressure of 9.8 atmospheres. The feed water temperature was 57 deg. Cent. This represents $28.81 \times 606 \times 10^3 - 17{,}459 \times 10^3$ Cal. The efficiency of the cooling apparatus thus works out to

$$\frac{17{,}459 \times 10^3}{21{,}770 \times 10^3} = 80.2 \text{ per cent.}$$

On the base of an efficiency of 80 per cent. the heat recovered per ton of coke amounts to $352 \times 10^3 \times 0.8 = 282 \times 10^3$ Cal. The calorific value of 1 ton of coke taken at 6500×10^3 Cal., thus the relative gain obtained is—

$$\frac{282 \times 10^3}{6500 \times 10^3} = 4.3 \text{ per cent.}$$

This gain referred to the actual amount of coke available for sale, which is about $\frac{5}{7}$ of the total output—$\frac{2}{7}$ being consumed in the gas producers serving the ovens—gives $4.3 \times \frac{7}{5} = 6$ per cent. increase or gain on the total obtained from the coke.

It may be mentioned that the average steam production during the month of December amounted to 425 kilos. per metric ton of coke.

Among other interesting tests were those made in order to estimate the amount of air entering the system through very small leaks in the various parts of the cooling plant. The larger part of the system is under positive pressure, a point of maximum pressure being that immediately in front of the fan corresponding to about 50 mm. water gauge, while the neutral point in the system lies between the two

boiler drums, and immediately behind the fan there is a vacuum of about 15 mm. water gauge.

With a closed circuit and the fan in operation, an attempt was made to measure the fall in the CO_2 content of the gases. When the experiment was made the coke in the chamber had already cooled to a black heat, and the average temperature in the chamber at the gas outlet was not more than 220 deg. Cent. It was found that in a period of two hours and fifty minutes the CO_2 content of the circulating gases fell slowly from 14.90 to 13.30 per cent. This was with an average volume of 120 cubic metres of gas in the system and a total CO_2 content of about 14 per cent. It will be seen that the rate of fall corresponds to 0.565 per cent. per hour, representing a change in composition equal to about 4 per cent. Assuming an average temperature of 400 deg. Cent., this means that 0.41 cubic metres of oxygen were taken in to enter into combination, and during the process of combustion this amount of oxygen would combine with 0.22 kilos. of carbon, producing 1770 Cal., *i.e.*, about 0.13 per cent. of the sensible heat of the coke. There are, however, certain periods occurring in the course of the cooling process at which it may be expected that greater changes in the composition of the gases take place. Thus, immediately after the cooling chamber is filled with a fresh charge of coke, the temperature of the mass rises quickly and then slowly recedes. The falling temperature causes a small reduction in the volume of gas in the circuit which is filled from the outside atmosphere. From temperatures observed in various parts of the circuit and the calculated volumes, it is found that 21 cubic metres of oxygen which in combustion can combine with 11 kilos. of carbon are taken into the system during a working day, and can give 0.32 per cent. of the sensible heat of the coke. A small quantity of air also enters the cooling chamber at each charge and discharge. This quantity is difficult to determine, but in any case is so small that it does not to any extent affect the efficiency of the plant and the amount of steam generated.

In the following table we give a series of analyses which were made in pairs, one immediately after charging the chamber, and the next immediately preceding the following charge. The time between the observations is noted by the figures given in minutes at the head of the table.

	Time between observations.							
	13 min.		20 min.		19 min.		16 min.	
Test No.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
CO_2	6.5	7.0	8.6	8.8	13.3	12.4	12.5	11.7
O_2	0.2	0.2	0.3	1.0	0.3	0.7	0.3	1.2
CO	6.7	6.6	0.9	0.4	4.5	4.5	7.0	6.5
CH_4	2.6	2.2	2.0	1.1	0.2	0.2	0.1	0.1
H_2	18.4	11.9	11.4	6.7	0.4	1.3	3.8	1.7
N_2	65.6	72.1	76.8	76.0	81.3	80.9	76.3	78.8

The proportion of the various gases present would seem to indicate that the hydrogen is burned at an early stage and takes from the incoming air the oxygen necessary for combustion, but apart from this no further combustion would seem to take place. The CO_2 content increases only comparatively slowly, or not at all. It would follow, therefore, that the combustion of carbon is taking place to a minor degree as might be anticipated from the amount of oxygen present as previously stated. It may also be remarked that there is little change in the amount of CO present. The presence of the hydrogen is due to coal which is not completely carbonised entering the chamber along with the coke.

The following analyses, which were made immediately after the final charge at the end of a working period had been given, show that apart from the hydrogen very little burning has taken place.

	Time after last coke charge.		
	8 min.	53 min.	2 h. 25 min.
CO_2, per cent.	7.3	10.9	13.9
O_2 "	0.4	1.4	2.1
CO "	14.0	6.8	2.1
CH_4 "	1.5	1.5	0.0
H_2 "	8.9	1.9	0.1
N_2 "	67.9	77.5	81.8

These figures show that after eight minutes there is combined oxygen present in amount equalling 14.3 per cent., and this figure remains constant after 53 minutes and increases to 15 per cent. after 2 hours and 25 minutes, the percentage of free oxygen slowly increasing in the meantime.

From this, the conclusion may be drawn that, owing to the unavoidable porosity of the walls of the cooling chamber and the prevailing difference in temperature in different parts of the chamber, air is entrained and combustion of the coke takes place on a very small scale. The amount of combustion is, however, of little practical importance because the temperature throughout the system is not high enough to enable combustion to take place.

Other experiments were made in order to investigate the possibility of any danger of an explosion taking place within the chamber. The explosive constituents are dependent entirely on the amounts of oxygen, carbon monoxide and hydrogen which, at any one time, are present in the gas mixture. From the tables already given it is clear that the oxygen content is usually very small, and it falls practically to zero immediately after a fresh charge of coke has been put into the chamber. It rises slowly as the working period progresses, and probably reaches the maximum in the early hours of the morning, when the highest reading recorded has shown as much as 3.60 per cent. present. At this time, however, the chamber is in a comparatively cool state, and the content of explosive gases at a minimum. The percentage of CO, on the other hand, averages as high as 10 per cent., and may rise up to 19 per cent. on occasion. According to the text-books the explosive range for CO_2 lies between 16.6 and 74.8 per cent., but this range is calculated for an air and carbon monoxide mixture, whereas in the case we are considering only flue gases are present with a very small percentage of free oxygen. Any danger of an explosion from this source may, therefore, be dismissed.

We have dealt briefly with some of the characteristics of the dry cooling process for coke and points which occur in its practical working. Some mention may now be made of the quality of coke produced. The dry coke is of a bright, light grey colour, and as it contains no moisture, its heating value is higher than that of coke cooled by the wet process. It also is produced in larger and more compact pieces, reducing greatly the amount of less valuable breeze and unsaleable dust. The steam produced by the plant may be used for a variety of purposes in a gasworks, and on a large installation it may be safely predicted that if it is used to generate electricity there will be not only enough current for the works, but it is quite possible that extra current will be generated enabling it to be sold to outside consumers at a profit.

Future Developments.

The plant we have described is the first commercial plant of its kind to be erected and tested. It has now been practically continuously in operation for a period of over sixteen months, and so successful have the working results proved that a duplicate plant of double the capacity with two further cooling chambers is to be installed. Several larger installations are under construction, and are projected both for Great Britain and the Continent. We have specially described a gasworks plant, but this field is only a small part of the application of the principle. Even larger scope is afforded in coke and by-product works, where steam and electrical energy produced in the cooling of the coke might be very advantageously used, supplying fuel for blast-furnaces where improved solidity and increased calorific value in the dry-cooled coke yields greatly improved results over those obtained by wet quenched coke.

Several large cooling plants for coke ovens are at present under construction, the most notable of which is that now approaching completion at the works of the Compagnie des Forges et Aciéries de la Marine et d'Homécourt, France, and designed to deal with 1000 tons of coke per day.

Further Experimental Work on Diesel Engines.*

By Engineer-Commander R. Beeman.

(*Continued from page* 488.)

Experimental Work.

Aluminium Alloy Pistons.

It is evidently necessary in the high-speed oil engine to reduce the weight of the moving parts. Some saving may be effected in such items as connecting-rods and crank shafts by careful design and high-grade material, but it is in the piston that the greatest scope exists for economy. These pistons, when of the trunk type, are designed with a number of considerations in view, viz., to act as a support of the gudgeon-pin, to provide the required thrust surface, and to act as a ring carrier. In general practice cast iron has been the material employed for these parts, but with the research work carried out in recent years aluminium alloys have been developed which have, in some cases, even better physical properties for the purpose in view than cast iron. As is well known, they are universally used for high-speed aircraft engines, and they are finding an increasing use in motor car practice. Their employment in larger engines is a logical outcome of the efforts to reduce the inertia effects attending high piston speed. The production of large pistons in aluminium alloy has not been without difficulties, but these have been surmounted and all the experimental engines are so fitted. A number of minor difficulties have arisen from time to time during the experimental work, and these are gradually being eliminated by variations in design and manufacture, and the experience with them at the present time is sufficient to warrant their employment as occasion demands in the Fleet. The alloy adopted for such pistons for the naval service has the following approximate composition :—

	Per cent.
Copper	3.0
Nickel	1.5
Magnesium	1.0
Iron	0.5
Silicon	0.5
Aluminium	93.5

With suitable precautions in the design and founding of large pistons—up to 25in. diameter—combined with subsequent heat treatment, tensile tests have shown results of 12 tons per square inch with elongation on a B.S. test piece 2in. long of 3 to 4 per cent. In the particular case of a large piston over 20in. diameter recently manufactured a tensile strength of 20 tons was obtained, the casting being sound throughout and free from any deleterious effects of the heavy shrinkage which is a feature of cast aluminium alloy work. The experience obtained with these alloy pistons will be considered in a little detail. Table II. shows particulars of the experimental engines in which they have been fitted. The saving in weight of the reciprocating parts achieved in the Unit engine and the effect on the inertia forces were given in the 1920 paper. The piston of this engine was subjected in its early days to severe loading—up to 150 lb. per square inch mean pressure—and found generally satisfactory. It has been in use since that time until quite recently, and has proved to be generally suitable for continuous service. The engine has been in regular use for experimental purposes running at or about the nominal load—100 lb. per square inch. Such defects or failings as it has developed during the period are not attributable to unsuitability of the material, but are rather due to weaknesses in the structural design which further experience has remedied. This piston was recently removed to give way to an alternative design and was then carefully measured. A comparison of these measurements with those taken when the piston was nearly new early in 1917, showed no sensible indications of either growth or wear.

The high coefficient of expansion of aluminium alloys entails special precautions in design and in fitting, and the working clearances found necessary are at least 50 per cent. in excess of those required for cast iron. Naturally the tendency is to run the clearance as fine as possible, but it is known from laboratory experience, and with other engines on service, that the adoption of small clearances has led to their absorption under working conditions and seizure of the pistons. These seizures have incidentally demonstrated one possible advantage of aluminium pistons in so far as the damage has been confined to the piston itself, which, under such conditions, rapidly overheats and becomes soft, and the liner is in most cases not even scored.

It may be expected also from this property of the alloy that if other materials are fitted in association with the piston some effects of differential expansion would be observed. The slackening of the steel studs screwed into the top portion of the piston for attachment of the lower portion has been experienced. This was attributed originally to relative expansion effects, but it has since been demonstrated that this is not the correct explanation, and that actually the threads in the aluminium alloy yield. This effect can be minimised with care, but it has been judged desirable in larger pistons to provide for an alternative attachment with bolts and nuts.

The gudgeon-pin bushes are gripped between the two portions of the piston and to anticipate differential expansion it has been usual to arrange that when the two portions are secured together—with the gudgeon-pin bushes removed—the vertical diameter of the recesses should be about 0.005in. smaller than the bush diameter. Thus, with the bushes fitted in place and the two piston halves abutting, a compressive stress is set up in piston and bushes. Under heated conditions it is estimated that the bushes should then never be slack in the piston. It has been found, notwithstanding, in this particular engine and in similar engines on service, that a peculiar type of hammering action takes place on the outer surface of the bushes in the regions under load which leads to distinct depressions there, but no sign of the action is discernible on the adjacent portions of the aluminium piston itself.

Signs of the action of the bushes, although to a lesser degree, have also been observed in the Digit engine, but, although an attempt has been made to reproduce the action in a special bearing testing machine, it has not been found possible to do so and its exact cause remains

Table II.

Designation of engine.	Type.	R.P.M.	Cylinder diameter, inches.	Stroke, inches.	Mean piston speed, feet per minute.	Piston.	
						If cooled.	Description.
Unit	4-cycle S.A. solid injection	380	14½	15	950	No	Piston in two portions divided at gudgeon pin axis, studs in top half
Digit	4-cycle S.A. air injection	390	20	26	1330	Yes	As above, but two portions connected by bolts
Opposed-piston Doxford type*	2-cycle S.A. air injection	380	14.35	28.34 (combined)	850	Yes	Each piston in one piece
Stepped piston†	2-cycle S.A. air injection	380	18	20	1300	Yes	Piston in one piece
"H" class	4-cycle S.A. air injection	375	9	12	750	No	Piston in three portions ; head and skirt of aluminium alloy, distance piece of cast steel

* This engine is also fitted with an aluminium alloy scavenge piston.

† This engine is fitted with a 25½in. aluminium alloy supercharge trunk piston, which carries the gudgeon pin on the power line. It is connected to the power piston by a steel distance piece.

* Read at the spring meetings of the sixty-fifth session of the Institution of Naval Architects, April 11th, 1924.

obscure. Meantime, the defect has been remedied as required by an alternative material for the bushes, and in another case by an alternative design of bush having square backs. The aluminium alloy portions of the piston constituting the ring-carrying portion have proved satisfactory and, beyond an increase in width of about 0.004in. in the groove for the upper piston ring after long service, no appreciable wear has been observed. Special attention was given to the ring design. The rings are made ¼in. wide, measured in the direction of the stroke and, in order to obtain the maximum bearing surface on the piston, as thick radially as is possible, consistent with attaining the necessary flexibility for assembly.

The Digit piston, which is oil-cooled, shows no appreciable wear or distortion. The slight differences in its construction compared with that in the Unit engine and the fact that it is oil-cooled, have eliminated the defects experienced with the early design. This engine has had a considerable amount of running at high load, and the experience, both with the design and material of the piston, has been entirely satisfactory.

The opposed piston engine of the Doxford type has, of course, a different design of pistons, these being merely ring-carriers which are attached to the external crossheads by means of steel rods. As originally constructed, this engine was fitted with pistons of cast iron, but in conformity with experiments carried out in the other experimental engines it was decided that pistons of aluminium alloy should be fitted to determine their suitability in an engine of this type where, in the absence of a cylinder cover and also due to the fact that the engine works on the two-cycle principle, more severe conditions in the way of heat stresses may be expected as compared with a four-cycle engine, other things being equal.

Before proceeding with the trial of pistons of "all" aluminium alloy, it was decided to try aluminium pistons fitted with steel crowns partially cooled. Such pistons are

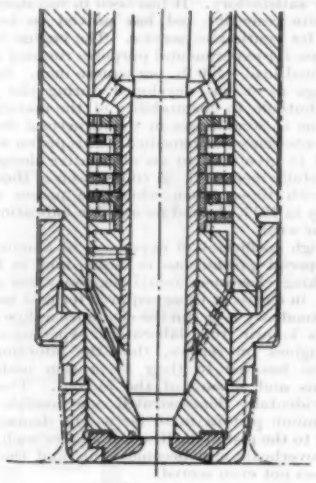


FIG. 1.

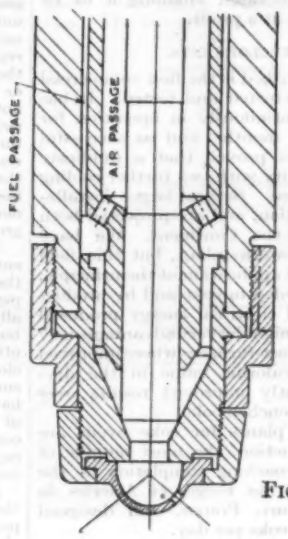


FIG. 2.

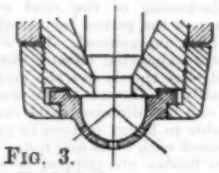


FIG. 3.

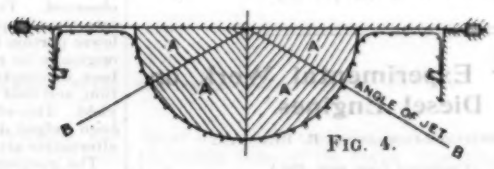


FIG. 4.

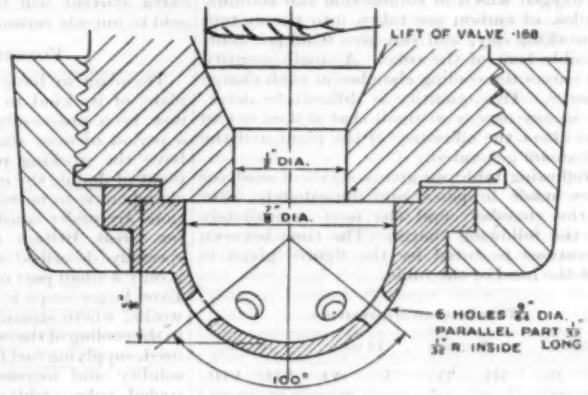


FIG. 5.

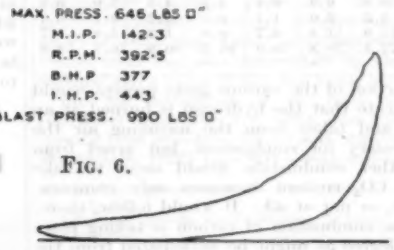


FIG. 6.

generally referred to as "incandescent" pistons. The design proved generally satisfactory, but it was found, as might be expected, that the steel crowns showed a certain amount of wastage due to burning or erosion, especially in the case of the upper piston. Since the scavenge air enters at ports which are uncovered by the lower piston at the bottom of its stroke, whilst exhaust takes place through ports uncovered by the upper piston at the top of its stroke, the plate on the lower piston reaps most of the benefit obtained from the cooling effect of the inlet scavenge air, and a higher average temperature would therefore be expected at the upper piston.

These "incandescent" pistons have subsequently been replaced by all aluminium alloy pistons which have now been on service eighteen months. The engine has been in regular use to supplement the electrical power requirements of the laboratory, its average load being from 140 lb. to 160 lb. mean pressure at 300 revolutions per minute. At a recent examination these pistons were found in very good condition, and there were no signs of erosion or burning. In the case of the upper piston alone, has any irregularity been observed, and that was some slackening of the studs screwed into the aluminium alloy for the attachment of the piston-rod. The behaviour of the alloy pistons in both the power and supercharging cylinders of the stepped-piston engine has been satisfactory, but this engine has not yet been subjected to its full load.

Due to the high heat conductivity of these aluminium alloy pistons combined with the special attention given to other parts to secure efficient cooling under load, it has been found necessary to work to comparatively high-compression pressures to obtain easy starting. The compression pressures obtained under load in the experimental engines are of the following order :—

Unit engine (solid injection)	380 lb.
Digit engine (air injection)	435 lb.
Doxford engine (air injection)	510–515 lb.
Stepped piston (air injection) ..	Not less than 520 lb.
"H" class piston (air injection)	400 lb.

For comparison with these figures, as illustrating the precise effect of the alloy pistons, it may be stated that in the case of the Doxford engine, 400 lb. was worked to with cast iron pistons and 490 lb. with the "incandescent" pistons.

1. DEVELOPMENT OF HIGH MEAN PRESSURES.

The high speed of revolution shown to be necessary in the naval engine makes the successful attainment of high mean pressures in the cylinders more difficult owing to the lesser time for the operations of fuel injection and combustion and for heat flow. The expression, "mean pressure," referred to here and elsewhere in this paper signifies the mean indicated pressure.

It is proposed to consider some of the problems intimately connected with the attainment of high mean pressures, and to describe some of the work carried out in attempting to arrive at their solution. These problems may be grouped conveniently as follows. Those associated with :—(1) The successful injection, at the high speed of operation, of the large quantity of fuel required per cycle. (2) The determination of a suitable profile for the fuel cam actuating the sprayer. (3) The shaping of the combustion space. (4) The high rate of heat flow and the stresses resulting therefrom. The difficulties associated with (1) and (2) are obviously closely related. It is, however, convenient to consider under (1) those questions more particularly appertaining to the fuel sprayer.

The air injection method will only be referred to, in so far as it gives, in the present state of development, the most efficient combustion when developing mean pressures of the order of 130 lb. per square inch and above. It may be stated, however, that the success so far achieved with air injection of the fuel, when working with mean pressures of the above order, is undoubtedly due, in part, to the supercharging effect of the blast air.

A consideration of the conditions under which fuel injection has to be effected in high-speed engines developing high mean pressures leads to the conclusion that the usual fuel-spraying device, which consists, in the main, in forcing the fuel with injection air through a number of small holes in a series of washers—as shown in Fig. 1—is unsuitable. This conclusion was fully confirmed by the early tests carried out on the Digit engine, and referred to in the 1920 paper. It would appear that the frictional resistance incidental to forcing fuel and air through the tortuous passage offered by the small holes in the pulverising washers, and through in addition, perhaps, some form of director nozzle, may be so great as to preclude the possibility of passing the requisite amount of fuel in the short-time period available. As a result, the fuel accumulates and fills the fuel valve casing, &c., which leads in effect to a "solid injection" system, but with a nozzle totally unsuited to such conditions. In consequence, the combustion is bad.

The essential feature, therefore, of the fuel sprayer to meet the conditions under review is a comparatively free passage for the fuel right down to the seating of the valve itself—with the form of nozzle shown in Fig. 2. It is beyond the valve seating that advantage must be taken of the velocity energy, obtaining in the fuel and air, for effecting whatever degree of pulverisation is possible or desirable. It will be evident that any attempt at controlling the distribution of the fuel, throughout the cylinder combustion space, can only be effected beyond the valve seating. It would appear, therefore, that an additional feature to be embodied in the fuel sprayer under consideration is a small chamber situated beyond the valve seating in which some degree of pulverisation can be obtained and upon leaving which a directional flow can be ensured. The design of this chamber, or nozzle, or its equivalent, has been found to be of great importance to the successful injection of fuel and consequent running of the engine.

A large number of these nozzles—shown in Fig. 3—with varying sizes and angles of holes have been tried on the Digit and other engines. The type of nozzle indicated is suitable for a combustion chamber of hemispherical form and would require some modification for use with other forms of combustion chamber. The precise number, size, and angle of the holes in the nozzle necessary to ensure correct spraying of fuel are, of course, dependent upon a number of factors, including the amount of fuel to be injected, the time period of injection and the shape of combustion chamber. But experience shows that it is hardly possible to lay down any definite rule for calculating them, and any estimate for a new design is necessarily, even after taking some account of the new conditions, a rough shot; so the suitability requires to be demonstrated by actual tests in the engine. Generally speaking, however, it may be stated that, for the type of engine under consideration a nozzle having a large number of small holes will not produce the correct type of spray or jet. For, whereas such a nozzle may give excellent pulverisation, the jets lack penetrative energy; an essential feature in the injection of the fuel.

Further, it appears likely that the large number of jets issuing from the nozzle tend to coalesce and so diminish the efficiency of the spraying. It has also been found that with a combustion chamber of hemispherical form, a nozzle having one of its holes disposed on the centre line—see Fig. 3—invariably gives inferior results. This is doubtless due to the fact that the volume of air with which the central jet is associated in spraying, is a very small percentage of the total volume of the combustion chamber, and in consequence the central jet has insufficient air for its efficient combustion. In other words, the proportionate mixing of the air and fuel throughout the combustion chamber is not realised.

A further point of general interest in connection with the design of nozzles may be noted. It is the practice at the laboratory to "radius" the inner edge of the holes in order to reduce "eddying" and "fringing" of the jet; it is considered also that this tends to maintain the desired directional flow. This latter point is of importance, as it is essential, if the best results are to be attained, that the fuel jets be directed at a particular angle with the vertical axis of the sprayer in order that the mass of air in the combustion chamber, on either side of the line of spraying, is approximately equal. That is to say, the jets must be directed towards the centre of mass of the volume of air with which they are respectively associated. Reference to the diagram reproduced in Fig. 4 will make this point clear. In the figure the volumes of air represented by A are equal, the line B representing the direction of flow of the jet.

Reference may be made to the most recent type of nozzle fitted in the Digit engine, which has enabled mean pressures of the order of 130–140 lb. per square inch to be developed at 390 revolutions per minute. This nozzle is shown in Fig. 5, and its particulars follow :—

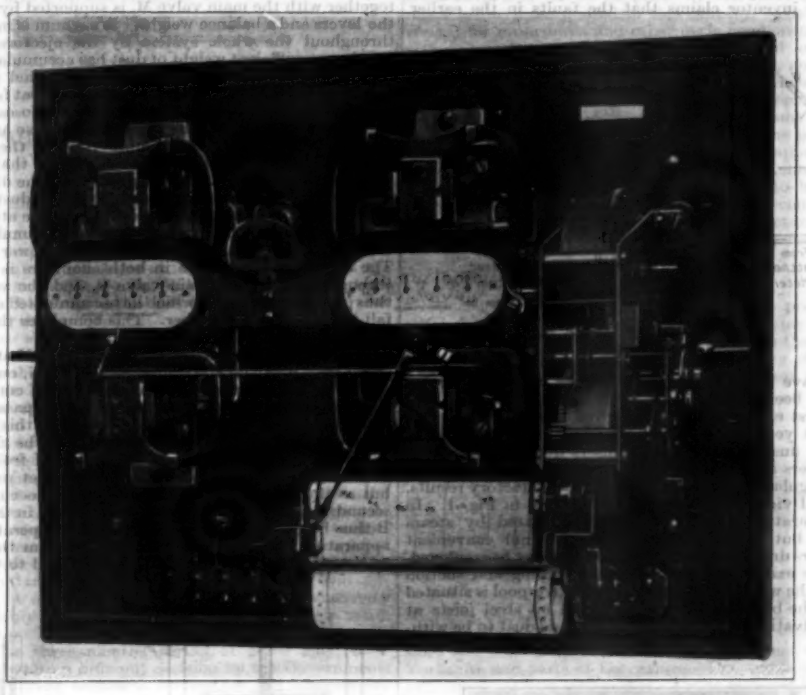
Number of holes	Six
Diameter of holes	9/64in.
Included angle	100 deg.
Inside edges of holes radiused 1/32in.	

Attention may be directed to the comparatively thin walls of the nozzle chamber and the short length of the parallel portion of the holes. The latter reduces the frictional resistance to flow and enables a slightly smaller hole to be used; this in turn renders the nozzle more adaptable for dealing successfully with the lighter loads. An indicator card, taken during a test with this nozzle fitted, is shown in Fig. 6. The mean pressure of the diagram is 142 lb. per square inch. A record of the test shows that the engine ran steadily, developing 377 brake horse-power, excluding the air compressor. The fuel consumption was 0.332 lb. per indicated horse-power and the exhaust was clear. This is not regarded as being the upper limit to which the power development can be carried. Already, at lower speeds, mean pressures of 155 lb. per square inch have been successfully developed without supercharging, and the possibilities of carrying the high mean pressures at the higher speeds of revolution are being explored. It has been found that some modifications may be necessary in the main heat stressed members, comprising the combustion chamber, to permit this further development. This aspect will be dealt with later.

(To be continued.)

A NEW KILOVOLT-AMPÈRE DEMAND METER

THE AMERICAN WESTINGHOUSE ELECTRICAL & MANUFACTURING CO., PITTSBURG, ENGINEERS



A New Electricity Meter.

An ingenious alternating-current meter, which gives a direct reading of power factor, total kilowatt-hours, kilovolt-ampère hours, and the kilowatt and kilovolt-ampère demand for any predetermined period, and also the power factor for over any period, has been introduced by the American Westinghouse and Manufacturing Company. The meter is shown above, and the mechanism, which gives a vectorial addition of the quantities which make up the kilovolt-ampères in Figs. 1 and 2. The kilovolt-ampères are equivalent to the square root of the sum of the squares of the true watt hours and the reactive watt hours. In a polyphase circuit, watt hours are readily measured with a standard two-element meter, and for practical purposes a similar watt-hour meter may be connected with its voltage coils arranged with a quadrature connection, so that for most commercial loads it will give a satisfactory reading of reactive component.

In the new meter the two elements, which measure power, and the reactive component are mounted side by side and a ball mechanism is mounted between them, and mechanically connected as shown in Fig. 3, so that the ball is driven by the two discs d-1 and d-2, and, in turn, the ball drives the wheel w. The condition shown in Fig. 3 corresponds to a 70.7 per cent. power factor, when the current in a polyphase circuit lags behind the voltage by an angle of 45 deg. Under these conditions, the watt-hour meter and reactive meter speeds are exactly equal. It is evident, then, that the ball will rotate about a horizontal axis $x\,y$. If the radii a and b are drawn from the point of contact of the wheels d-1 and d-2 perpendicular to $x\,y$, the lengths a and b will be proportional to the watt-hour and reactive meter speed. The wheel w rotates at a speed proportional to the radius of the sphere, which is somewhat greater than a and b. The two triangles a, b, c are equal, and it can be proved that they are equal for all power factors. c, the radius of the sphere, is equal to $\sqrt{a^2 + b^2}$, and therefore the device gives a true vector addition. The angular motion of the wheel w is equal to the vector sum of the motions of the watt-hour and reactive meter elements, and is equivalent to the kilovolt-ampère hours. The wheel w is mounted in a frame, which moves about an axis perpendicular to the plane, in which $x\,y$ moves, and, if extended, the axis of the frame would pass through the centre of the ball. As the axis of rotation of the ball shifts, the position of w changes, so that it always rotates on a great circle with a speed proportional to the radius c. Through a train of gearing the wheel w is connected so as to drive the left-hand dials on the meter, which then register kilovolt-ampère hours. This regulator is similar to registers used on watt-hour demand meters, and is similar to the register on the right-hand side of the meter. On the left-hand register there is a short arm, which through a connecting-rod drives the pen on the right-hand element. The right-hand register is connected to the watt-hour meter in the usual manner, but instead of operating a pen, the demand mechanism carries a small adjustable stop, which moves about the same centre as the pen driven from the kilovolt-ampère element, but as the kilowatt load is always equal to or less than the kilovolt-ampère load, it lags behind. At the end of the time interval, when the clock resets the demand mechanism, the kilovolt-ampère element is reset first and makes a well-defined mark at the end of the line on the paper. The pen falls back to the stop and makes a mark on the paper at that point. A fraction of a second later, the kilowatt element also resets, and the pointer returns to zero. The record on the chart then gives both kilowatt and kilovolt-ampère demand, and by simple calculation the power factor for the time interval may be obtained by dividing the kilowatt by the kilovolt-ampère demand. The indicated power factor at any time may be obtained by inspecting the position of the pointer carried by the frame on the ball mechanism.

The diagrams—Figs. 4, 5, 6 and 7—show the different positions of the axis of rotation of the ball. In Fig. 4 the watt-hour meter speed is slightly greater than it is in the case of Fig. 3, and the radius a is greater than the radius b. In this instance, the power factor is approximately 80 per cent. In Fig. 5 the reactive meter is at rest, and the ball rotates about an axis passing through the point of contact of the disc d-1. In this position it is clear that there is a 1 to 1 ratio between the disc d-2 and the wheel w, with a resulting kilovolt-ampère hour registration equivalent to the kilowatt-hours. As the power factor becomes less than 100 per cent., the reactive meter starts to rotate, and, referring to Fig. 4 again, the relation of $\frac{a}{c}$ is the cosine of the angle which measures the departure of the axis $x\,y$ from the unity power factor position. In Fig. 6 the mechanism has reached the zero power factor position, and the axis $x\,y$ passes through the contact of the disc d-2, the watt-hour meter being at rest. In this position there is a 1 to 1 ratio between the reactive meter disc and the wheel w, making the reactive watt hours equivalent to the kilovolt-ampère hours. With a leading power factor, the reactive element reverses, and Fig. 7 shows how with a 70.7 per cent. leading power factor, the axis of rotation is vertical, but the wheel w still gives a correct integration of the vectorial sum of the motions which go to make up kilovolt-ampère hours. This could be carried through the whole circle diagram of leading and lagging power factor and reverse power, but with reverse power the wheel w would have to be driven

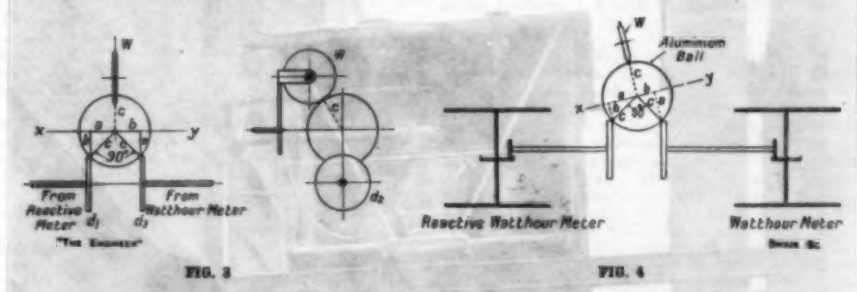
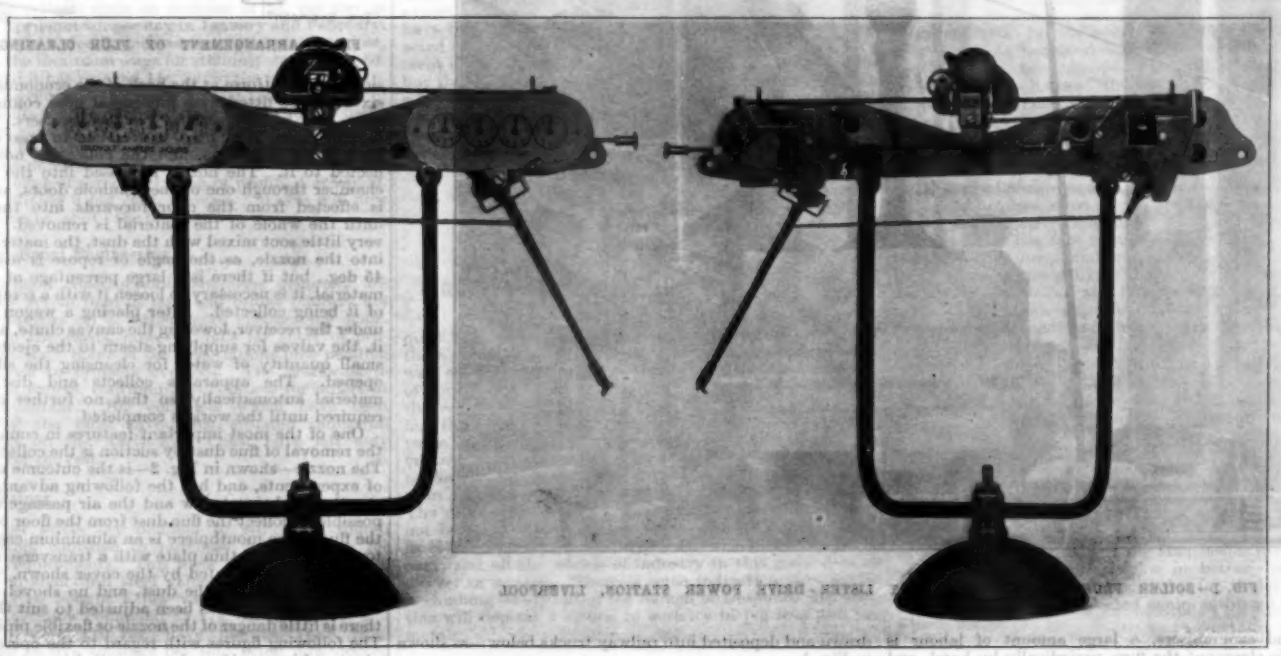


FIG. 3 FIG. 4



FIGS. 1 AND 2—FRONT AND REAR VIEWS OF REGISTER

from the lower part of the ball, and that would present difficulties.

No errors due to slipping of the friction drive arise. Measurements have shown that the power required to operate the pen and the kilovolt-ampère counter mechanism is only one-eighth of the power required to slip the wheel w on the ball, and by checking the rotation of the watt-meter discs against the record on the chart, it was found that the ball operates correctly.

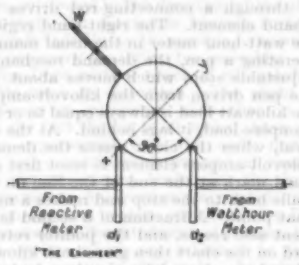


FIG. 5

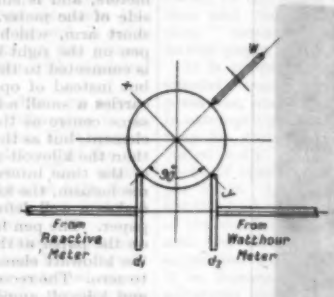


FIG. 6

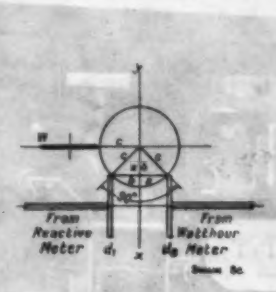


FIG. 7

Boiler Flue Cleaning Plant.

THE removal of dust and soot from the flues of steam boilers and the internal parts of economisers is a subject that is deserving of more attention than it commonly receives, for efficiency and economy of fuel in steam generation depend to a considerable degree upon clean flues. In steam raising plants comprising a large number of boilers and economisers, a large amount of labour is required to clean out the flues periodically by hand, and the operation is a very unpleasant one for those engaged upon it. There are now several types of plant on the market for this purpose, the latest being one that has been designed and patented by Mr. W. G. Hay, and is made by Blowers and Exhausters Limited, Carver-street, Old Trafford, Manchester. Mr. Hay has been engaged on this class of work for some years. His first attempt was a steam ejector plant, which collected and discharged the dust automatically. In this apparatus, the discharge door or valve was operated by a steam cylinder, the valve of which was opened by the weight of dust collected in a float chamber. This plant comprised a single chamber in which about 3 cwt. of ashes were collected and discharged periodically. Although fairly satisfactory, this apparatus left room for improvement. In Mr. Hay's newly designed plant the inventor claims that the faults in the earlier design have been eliminated, while the amount of steam used has been reduced.

The first example of the improved apparatus was supplied last year to the Liverpool Corporation for dealing with the dust in twelve economisers attached to water-tube boilers at the Lister-drive power station, where it is still in regular operation, and is giving satisfactory results. A general view of the apparatus is shown in Fig. 1. In this apparatus a partial vacuum is created by steam ejectors, but where that arrangement is not convenient exhausters driven by any suitable means may be employed. With the exception of the necessary piping and suction nozzles, the whole of the apparatus at Liverpool is situated outside the boiler-house, and is carried on steel joists at such an elvation as will enable the soot and dust to be withdrawn and deposited into railway trucks below—as shown in Fig. 1.

FIG. 1—BOILER FLUE CLEANING PLANT AT LISTER-DRIVE POWER STATION, LIVERPOOL

Referring to Fig. 2, A is the inlet or suction pipe for the dust, B is an upper chamber or receptacle in which the dust is intercepted, C a conical valve, and C^1 a pilot valve, D D are the steam ejectors, E E silencers and F F the exhaust pipes. G is the pipe for conveying steam from the boilers to the ejectors, H is a lower chamber fitted with a hollow float J, in which is another conical valve K, which seats against the lower end of the float guide L. M and M^1 are a further valve and a pilot valve, which control the deposits of ash into the discharging chamber N. The dust-laden air passes through the suction pipe A to the upper chamber B, the dust falling into the float J, while the air with a small percentage of dust passes through the ejector D with the steam into the silencers E. The float J is fastened to the spindle of the pilot valve M^1, and, together with the main valve M, is supported by means of the levers and a balance weight. A vacuum is maintained throughout the whole system by the ejectors. When, however, a sufficient weight of dust has accumulated in the float J to overcome the balance weight O and the atmospheric pressure on the pilot valve M^1, the float falls, opens the pilot valve, and, by the linkage shown, closes the main and pilot valves C C^1 of the upper chamber, so as to maintain the vacuum in the chamber B. Air then passing through holes in the main valve M causes that valve to fall, and the accumulated dust passes into the discharging chamber N. When nearly the whole of the dust has been discharged, the balance weight overcomes the atmospheric pressure on the pilot valve C^1, and opens it, simultaneously closing the main and pilot valves of the lower chamber. The atmospheric pressure in both chambers is equalised through holes in the main valve C, and the valve falls, thus permitting the dust which has accumulated above it to fall into the lower chamber. This completes the cycle of operations.

The dust is discharged from the chamber H at a greater speed than it can escape from the chamber N, owing to the difference in the areas of the openings, and consequently the whole of the material is permitted to pass from the chamber H before the valves close. But for this provision, some of the dust would be trapped inside the chamber H and would probably prevent the valve M from closing. The air passes at the rate of 100 cubic feet per minute, but as the movement of the valve C only occupies a few seconds, the slight reduction of the vacuum in the receiver B thus brought about does not affect the operation of the apparatus. The 3in. pipe A is carried from the receiver to the main air pipe of the same bore fitted to the under-side of the platform at the back of the economisers, having six branches fitted with gun-metal hose connections and caps, one branch serving two economisers. A flexible metallic hose, 2½in. bore, is attached to hose connections by screwed couplings, and the collecting nozzle is connected to it. The nozzle is passed into the economiser chamber through one of the manhole doors, and cleaning is effected from the door forwards into the chamber, until the whole of the material is removed. If there is very little soot mixed with the dust, the material will flow into the nozzle, as the angle of repose is usually about 45 deg., but if there is a large percentage of soot in the material, it is necessary to loosen it with a scraper to allow of it being collected. After placing a wagon in position under the receiver, lowering the canvas chute, and securing it, the valves for supplying steam to the ejectors and the small quantity of water for cleansing the silencers, are opened. The apparatus collects and discharges the material automatically, so that no further attention is required until the work is completed.

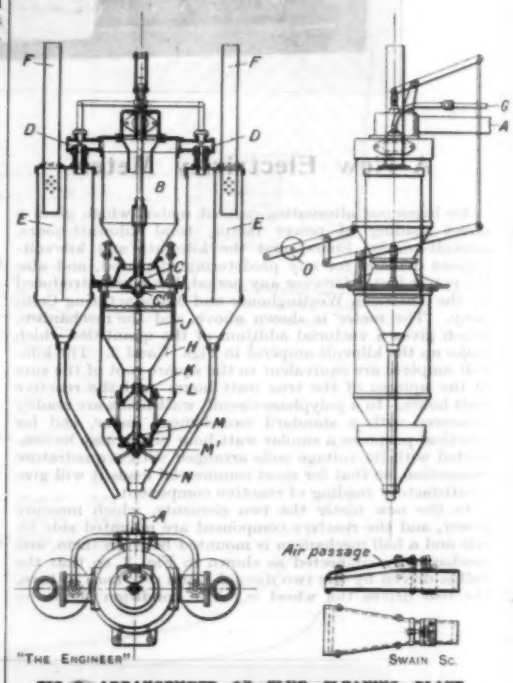


FIG. 2—ARRANGEMENT OF FLUE CLEANING PLANT

One of the most important features in connection with the removal of flue dust by suction is the collecting nozzle. The nozzle—shown in Fig. 2—is the outcome of a number of experiments, and has the following advantages:—The mouthpiece being below and the air passage above, it is possible to collect the flue dust from the floor or bottom of the flue. The mouthpiece is an aluminium casting on the top of which is a thin plate with a transverse air passage, which can be regulated by the cover shown. The nozzle can be pushed into the dust, and no shovel is required. After the air inlet has been adjusted to suit the material, there is little danger of the nozzle or flexible piping choking. The following figures with regard to the operation of the plant at Liverpool have been supplied to us by the makers. Steam consumption, 750 lb. per hour; air displacement, 220 cubic feet per minute; vacuum, 7½in. mercury (approximate); cost of steam with coal at 15s. per ton, about 6d. per ton of ash removed. Only two men are required for two hours for cleaning each pair of economisers, compared with six men working for six hours when cleaning by hand.

At first sight it might seem that there are several parts in this plant which are liable to stick and give trouble,

owing to the dust, but all the parts are made with ample clearance, and we are informed that no difficulties have been met with on this score, a certain small amount of dust or soot, however, seems to find its way into the exhaust steam, which it would be advisable to prevent by turning the steam into a further chamber.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Motor Engineers' Hopes.

THE proposed abolition of the McKenna duty on foreign imported motor cars, which has so important a bearing on the industries of this district, continues the chief subject of discussion in Midland engineering circles, and it would now appear fairly certain that between now and August, the extended date appointed for its extinction, every effort will be made to secure the retention of the duty. Any step which involves the curtailment of activity in the motor car factories hits almost the whole range of the Midland metal trades, as well as important branches of the glass, leather, rubber, woodworking, and other related industries. How widespread the reactions are likely to be may be gathered from the fact that already projected augmentations of plant have been postponed. Orders for machine tools, which would have afforded valuable aid to a badly hit branch of the engineering industry, are held up, and there is no present prospect of the negotiations being reopened. It is not, of course, suggested that the abolition of the McKenna duty will extinguish the motor car industry, but the most promising part of the trade, that relating to light cars, will undoubtedly be seriously jeopardised, and the new activity will inevitably be greatly checked. The view now taken is that the position has become one of considerable uncertainty. The three months period of grace may, it is thought, produce a different decision by the Government, and in any event contracts for motors and components will be held up because agents and buyers will be unwilling to engage business freely until the new conditions and prices are known. It will also upset calculations for next year's programme, owing to the delay. If the Government, as is sincerely hoped hereabouts, can be persuaded to renew the duty then all will be well, but if not, Coventry and other Midland motor engineering centres will again have to face severe depression.

Staffordshire Iron and Steel Institute.

Although a slight increase in membership was reported, the Council of the Staffordshire Iron and Steel Institute, in its report to the annual meeting, regretted that owing to a large proportion of members' subscriptions being in arrear there was a loss on the year of £96 4s. 3d., which reduced the credit balance of the Institute from £414 to £318. Mr. H. P. Jacks (Birmingham) was elected president, Mr. A. D. Lewis (Dudley) vice-president, and Mr. James Piper treasurer. For the thirtieth successive year Mr. C. Hubert Plant (Walsall) was re-elected secretary.

Wage Increase for Miners.

Miners in the Cannock Chase coalfield, in common with those of Warwickshire and others in the Eastern area, are to have the biggest increase in wages for the months of May and June that they have had during the two and a-half years the wages agreement has been in operation. The advance is one of 13.32 per cent., which represents an addition of 10d. per day or 5s. 6d. per week to stallmen's wages. This follows upon an increase of 2d. per day in March and April and 7d. per day in January and February. There has been a steady increase in wages since August, 1923, when the minimum wage for stallmen stood at 8s. 8d. per day, until it has reached 11s. 3d. in the present month. The latest advance is the result of the ascertainment of working results for January and February. The accountants' figures gave a wage rate for May and June of 71.78 per cent. on the standard, against 58.46 per cent. for the two previous months. This is on the old basis, and the coalowners' offer of a reduced ratio of profit, if accepted, will give a further 5 per cent. increase. Wages will now be 41.78 per cent. above the minimum.

Constructional Engineering.

Midland constructional engineers generally are a little more active than of late, and bridge builders are receiving inquiries on a rather more encouraging scale. The work in the yards, however, falls far short of productive capacity. Some of the negotiations now pending have reference to projects overseas. The Staffordshire district is, of course, continuing to compete for orders at some disadvantage. Big contracts which have been procured by the most favourable situated industrial organisations on the North-East Coast have left only smaller fry for the rest.

Steel Values.

Steel prices are inclined to stiffen all round, though buyers continue to purchase supplies only for immediate requirements. This week there has been some movement in structural steel values. Angles and joists, which could be bought a few weeks ago at £9 15s. or something less, now command £9 17s. 6d. up to £10, and tees, which were £10 15s., have likewise risen from half-a-crown to five shillings per ton, being now quoted £10 17s. 6d. to £11. Small steel bars are quoted at £10 5s., but this price is cut in exceptional cases. In view of fuel prospects and industrial conditions generally, any fall in prices is regarded as a remote contingency. For billets about £8 5s. is asked. Hardly any new orders are being placed with continental producers just now, though Belgian steel makers are once more seeking orders, offering billets at prices ranging between £7 10s. and £7 12s. 6d. At these figures the material offers too slight an advantage to be attractive. There are still large arrears of foreign material to be delivered, and the new offers contemplate supplies by the middle of June. Transport is, however, no longer impeded by congestion at ports, and deliveries are coming in more freely against old engagements. Substantial sales have been made of certain cold rolled steel strip and hoops supplied by Germany at prices much below those quoted in this country. The material is used for mudguards and other cycle components, made rather largely in Birmingham. The chief complaint amongst steel makers is the finely cut profits, and the rerollers would welcome cheaper foreign steel whenever it is available. This branch of the trade, however, has now to reckon with the condition imposed by some railways restricting the material to British steel. Some producers, both of half-products and finished steel, are apprehensive as to the result of the abolition of the McKenna duties. In one case a pending contract for billets to be spread over twelve months was not concluded on account of the Budget proposals, the buyer, a big manufacturer, being unprepared to commit himself beyond July.

Scrap.

Steel scrap is a weak market and prices have fallen further. The general market level to-day is somewhere between £4 2s. 6d. and £4 5s. delivered, the depressing influence in this case being some heavy shipments received by way of Newport, mainly for use in Welsh steel works.

Sheets.

Galvanised sheets are weak at £17 5s. to £17 10s. for galvanised corrugateds of 24-gauge. This is a competitive figure for most overseas markets, but new business is rather slow arriving. Tin-plates are slightly easier on account of the recent fall in values of tin.

Pig Iron.

The pig iron position in the Midlands is a little stronger, mainly because the Cleveland area has better overseas business, and is less competitive with Derbyshire and Northamptonshire iron in such areas as North Yorkshire and parts of Lancashire. Demand is not large, but values are well maintained. Crude material is in good supply. There is no superfluity of stocks of Midland brands, and with a few exceptions furnace owners do not appear to be perturbed by the disinclination of consumers to buy forward. The demands of the engineering trade for foundry iron show a little expansion. Derbyshire No. 3 foundry iron commands £4 15s. and forge £4 7s. 6d., Northamptonshire foundry £4 12s. 6d. and forge £4 5s., while North Staffordshire brands continue to be quoted, foundry £4 15s. and forge £4 7s. 6d. per ton at furnaces. A few continental inquiries have reached the Midlands, but in view of the high railway rates they do not appear to have led to actual business. Prices much above the £1 4s. at ovens, arranged between associated interests for renewal of contracts, have to be paid for furnace coke bought on the open market. Every effort is being made to get the coke price standard reduced at the forthcoming conference of blast-furnacemen and coke producers, and it is hoped these efforts will meet with more success than attended the last conference.

Finished Iron.

The Staffordshire finished iron trade continues to show some improvement, the chief complaint, however, being the difficulty of producing at a profit. Marked bar houses are best off for orders, but makers of medium material are moderately busy, the advanced price of £13 having been obtained. Wrought iron gas tube strip has shared in the rise and now sells at £13 5s. to £13 10s. Lancashire prices tend to be rather higher, chiefly because of the more favourable position of that county in regard to export business. Nut and bolt bars and fencing iron prices have hardened to £12, but little business is being transacted except for accommodation lots. The delays in shipment of No. 3 Belgian iron are gradually being overtaken, but there are still heavy tonnages to be delivered, and in a few cases nut and bolt makers have been obliged to buy Staffordshire material costing a good deal more than the foreign bars.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Outlook.

THE iron and metal markets are again very quiet this week, and people seem content to wait until there is some indication of a definite movement, one way or the other. At present there is little opportunity of forming an opinion. There is a general belief that the economic condition of Europe is slowly improving, but this process is not likely to be fast enough to affect trade favourably for some months, or perhaps a year or two, and meanwhile industry has to struggle along as best it may. What we want in Manchester more than anything else is a recovery in the cotton trade. The connection between this and iron and metals may not be clear to the outsider; but the fact is that so soon as cotton is prosperous money is expended on new machinery, and all the wheels of industry in this great district are set in motion. There is some indication that cotton is climbing slowly out of the Slough of Despond, and upon this will depend a return to activity in pig iron and the metals.

Metals.

The recent small movements in the copper market are rather disconcerting. We all keep saying amongst ourselves that copper is far too cheap, and that it must soon become dearer; but we have all been saying this for more than two years, and although it is perfectly true, no decided movement in copper prices comes to confirm its truth. Copper and spelter are the only two metals which are at pre-war prices. Relatively to the prices of these two metals, pig iron ought to be at 50s. per ton, lead at £12 to £15 per ton, steel billets at £4 per ton, and finished iron and steel at £7 to £8 per ton. Our readers know how far these products are now from such relatively correct prices. Ingot copper has been weak again in Manchester, and has in some cases been quoted below £67 per ton. The curtailment of production in America, which was designed to raise the selling prices, has no doubt produced some effect, but mainly in the direction of hindering a further fall in prices on that side. It is said by some experts that the lessening of the output of copper only just balances the decline in consumption. It is perhaps unreasonable to look for any great expansion in American consumption during the summer, but there is a chance of a better demand for copper in Europe, and this may cause a small advance in prices; but any return to really good prices for copper, anywhere near what the metal should be bought at, in relationship with the other non-ferrous metals, seems highly improbable. It is, of course, possible that a further reduction in the American output will take place; but some of the favourably situated producers are making quite a good profit as things are, and will not easily be persuaded to reduce output and profits for the sake of the less favourably situated properties. The market for tin has been erratic as usual, but, on the whole, the tendency is decidedly downwards. Not so long ago we were accustomed to see tin break below £260 and recover again; then later it took to breaking below £250 and recovering; now it breaks below £240, and if this process goes on any longer we shall have it dropping below £230. Any idea entertained by the optimists, of a recovery to the level before the great slump, may now probably be dismissed. Statistics remain good, and last month there was a decrease in the visible supply of over 3000 tons; but statistics seem powerless to sustain the market. In the market for lead there seems now to be some apprehension of large arrivals from Mexico. If the revolution there is over for good it is likely that Mexican supplies will soon be more important; and, of course, lead is still at a fairly high price. In spelter there has been a sluggish tendency and very little new demand, but the level of prices, unlike the lead prices, is very low.

Pig Iron.

The market in Manchester for foundry iron remains in a dull condition, but so far there has been no change in the prices. There are still one or two makers of Derbyshire pig iron who hold that the price obtainable is unremunerative, and who refuse to sell below 97s. 6d. at the furnaces, but with the result that they are getting no orders. Only a small demand for foundry iron exists here, and there are ample opportunities for buying on a basis of 95s., or, say, at 102s. 6d. delivered to this district, and the state of the foundry trade is such that makers of castings cannot afford to be indifferent about 2s. 6d. per ton on pig iron. There is at present scarcely any competition here with Derbyshire iron. A little Staffordshire is heard of occasionally, and on North Staffordshire iron the lower rate enables makers to get a rather better price at the furnaces. There is also a little Lincolnshire which costs somewhat more than Derbyshire foundry when delivered here; but it is only the comparative scarcity of this iron which enables the makers to command a small premium. The general character of the market shows very little alteration from week to week; but apparently there is no expectation, even amongst buyers, of lower prices for some time to come. Nothing further has been heard of the negotiations connected with the demand of the foundry makers for an all-round advance of 20s. per week in their wages; but one cannot believe that this will be conceded without a struggle. It seems a very strange time for men to be insisting upon higher wages in the foundry trade. One would be inclined to think that the industry has quite as much trouble as it can bear. Scotch pig iron inclines to be dearer here, and there are some brands which are held for 118s. 6d. per ton delivered; but good Scotch iron can still be bought here at 115s. to 115s. 6d. per ton. Some merchants seem inclined to "bear" this class of iron at the moment, but it seems rather a risky thing to do.

Steel.

The demand here for finished steel is only very small, but sellers are unable to stimulate it by any further reduction in price, even supposing that this would prove to be an effective stimulant. One doubts, however, whether price has now anything to do with the state of the market. Joists and angles are quoted at £9 12s. 6d. to £9 15s. per ton delivered here. Common steel plates are at £10 to £10 5s., and bars from £10 to £10 15s. per ton. There is an expectation that boiler-plate prices may soon be easier; and, in fact, the difference between boiler and ship plates has long been rather more than it should be.

Scrap.

Dealers in scrap remain in a depressed state of mind, and those who are most interested in cast scrap find that the accumulations are rather disconcerting. Founders are not using anything like an ordinary quantity, and the low prices do not induce them to increase their consumption, which would probably be the case if they had work. Broken machinery metal can be bought at 87s. 6d. to 90s. per ton here, and in the Manchester district generally. Heavy wrought scrap is in better demand, and some consumers are offering 105s. for it delivered, but steel scrap is rather neglected again, although it has been a little better.

Manchester's Municipal Trading Departments.

During the past few days details have been given of the results of the last year's operations of the two municipal trading departments, namely, gas and electricity, both of which appear to have had a very successful year. The gas undertaking eclipsed all previous records in spite of the general depression in trade. Its output last year—7,135,580,000 cubic feet—is the largest in its history. The largest one day's output was 30,000,000

cubic feet, which had never been equalled in a single day before; and the increase of output on last year—524,631,000 cubic feet—is its greatest annual increase. The total income for the year was £1,537,184, and the total expenditure £1,235,410. Interest and sinking fund charges amounted to £205,381, leaving a net profit of £96,393. With regard to the electricity department the sales of current during the year amounted to 222,203,023 kilowatt-hours, compared with 185,638,834 kilowatt-hours in 1922—an increase of 19.7 per cent. The maximum load on the stations during the year was 108,320 kilowatts, compared with 94,800 kilowatts in 1922–23. The gross income of the electricity department was £1,455,333, representing an increase of £78,816 over 1922. The charges for current show an allround reduction, the average charge for lighting being 4.442 pence, against 4.770 pence; the charge for power averaged 1.052 penny against 1.246 penny, and for traction 1.178 penny against 1.240 penny. The number of consumers has increased to 30,554. Further substantial reductions in the charges have been made for the current year, which will cost at least £160,000.

BARROW-IN-FURNESS.

Hematite.

There is an inclination on the part of some people to think that before long there will be an improvement in the hematite pig iron trade. We all know that better times are coming, but when they will arrive is another thing. Consumers are very chary at placing orders, and their requirements at present are not heavy by any means. We are not out of the wood yet, and until there is peace in the coal trade and a clear horizon in the shipbuilding and engineering departments, there will be the same hesitation to place good orders. At present stocks at certain works have got to be cleared before any more is produced. At Barrow the works are idle and customers are being supplied from stocks that exist in the yard. The continental trade is only moderate and a lot depends on the rate of exchange. The Midlands is taking a fair bulk of delivery, but Scotland is not a big customer by any means yet, though its requirements for the future are known to be fairly good. American trade is not strong. It is not known when the Barrow ironworks will recommence work.

Iron Ore.

The iron ore trade is very dull and the local requirements are very small. Some mines are bringing a limited quantity to the surface, whilst others are practically idle. Business in foreign ores is limited on account of the poor state of the iron trade, and there is not a big importation at the present.

Steel.

The steel trade is still very quiet, and there is no news of the works restarting either at Barrow or in Cumberland. There are not many orders in the market, and the competition is very keen. The Barrow hoop and section mills keep going and are likely to, as the orders held are satisfactory.

Shipbuilding and Engineering.

As hinted at for some time in these letters, the prospects in the engineering and shipbuilding departments are good, and evidences of these hints are now forthcoming. Apart from the substantial order for the cruiser—hull and machinery—there is sure to be a fair amount of work to do in the gun-mounting department at Barrow, for there are five cruisers in all to be built. The placing of an order for a passenger steamer similar to the Orient liner Orama, the tonnage of which is 27,000, is very welcome, and what is more, it is a complement to Vickers. The Orama will be launched on the twentieth of this month. The Warren Line has also ordered from Vickers, Limited, a passenger and freight steamer of 7030 tons deadweight for the Liverpool–Canada and Newfoundland service. She will be 405ft. long, have a speed of 14 knots, will carry 100 first and 80 third-class passengers, and is to be delivered next Spring. She will come under the management of Messrs. Furness, Withy and Co. On Tuesday there was launched at Barrow a steam collier for the Canadian Lakes to the order of Steamships, Limited, Canada. She is 2200 tons and is self-unloading. She is for service on the Great Lakes, the canals, and the St. Lawrence.

SHEFFIELD.

(From our own Correspondent.)

The Heavy Steel Branches.

THE production of steel in the big open-hearth furnaces of the district continues at a high level, and a large tonnage of partly finished material is being turned out, but the outlook is not considered favourable. Reports from most of the large firms show that they are working chiefly on old contracts, and that the booking of new orders has been falling off most of the year, while since Easter things have been exceptionally quiet. In North Lincolnshire a decline in activity is noticed, which is all the more striking in view of the fact that the steel works in that area have been enjoying something like boom conditions for months past. The booking of orders for billets is likely to be affected by the signs of a revival of continental competition in the cheaper classes.

Railway and Shipbuilding Work.

The departments manufacturing axles, tires, springs, buffers, and other railway requisites are producing large quantities of material, but they are not by any means overburdened with work. The plants have been extended so much that they are now capable of executing large contracts in less time than formerly and require more to keep them in full operation. Good orders are on hand from the British railway companies, and the forthcoming extensions of the London tubes and other additions to the country's railway facilities give promise of still further demands on the Sheffield plants, but the amount of work coming from abroad is below the normal. The demand for shipbuilding steel should look up owing to the placing of the orders for cruisers. One Sheffield shipbuilding firm—that of Vickers Limited—has had a good run of success in booking orders for new vessels.

Other Steel Departments.

A substantial amount of work is reported by most of the rolling mills of the city, but many of the orders are on the small side. Orders are coming in rather more freely to the crucible steel trade, but the depression which has brooded over it for a long time is far from being removed. There is also a better inquiry for files. Several firms, however, are finding the financial strain severe, work having been of an unremunerative character for some time, and cases are reported of business offers being refused because the seller was not in a position to give credit. The activity in the saw trade, previously noticed, is well maintained. Some of the firms, especially those engaged in the manufacture of large circular saws, are working under great pressure. There is a large demand for these articles from Japan, for the work of repairing the devastation caused by the great earthquake. The firms making wire and wire ropes continue well employed. The proposed scheme of levying duties on steel manufactures imported into India has been discussed by the Chamber of Commerce. India is a very important market for Sheffield steel productions, and it will be a very grave matter for the city's trade if the present recommendations are adopted by the Indian Government. Several branches of the city's industry are likely to suffer. There is perhaps some consolation in the prospect that the extension of manufacturing industry in India should be beneficial to Sheffield by bringing about an improved demand for the city's special tool steel and for many kinds of tools used in engineering.

The Cutlery Trade.

There is little improvement to report in the condition of this old staple trade of Sheffield. The output of stainless table knives shows some increase as compared with the earlier months of the year, but competition is extremely keen, with the result that, among those firms which cannot reduce prices to a minimum, there is only a moderate amount of employment. Increasing sales are reported by the firms who supply table knife handles. In the razor branch things are extremely quiet, but a satisfactory amount of business is being done by one firm, which is in the fortunate position of doing a large trade with Australia, where the old-fashioned razor is still used in preference to the safety pattern.

Mining Matters.

It was only last week that I referred to the hopes that coal would shortly be struck at the new Markham Main Colliery, near Doncaster. Those hopes have been realised even earlier than was anticipated, for on Monday the sinkers tapped the famous Barnsley bed in the No. 1 shaft at a depth of 730 yards. The seam is reported to be about the normal thickness and of good quality. It is expected that the No. 2 shaft will also be taken down to the coal in about a fortnight. The new pit will be a large one, and the number of men for whom it will eventually find employment is put at from 3000 to 4000. The colliery is to be fitted out on up-to-date lines; houses are being built as rapidly as possible at Armthorpe; and an important scheme of road development is contemplated. Further details are now available regarding the village which the Bolsover Colliery Company proposes to build at Edwinstowe in connection with the new Thoresby Colliery. The site lies to the west of the old village, within a few hundred yards of Sherwood Forest, and has an area of about 154 acres. The scheme provides for 956 houses laid out on modern principles, and includes the erection of an institute, drill hall, shops, schools, and places of worship, while provision is also made for a sports ground of 11 acres, playgrounds, open spaces, and a swimming pool. The necessary power for the Thoresby Colliery will be supplied by electricity from the other pits of the company, so that chimney stacks and black smoke will be obviated, and the woodland beauties of the district will not be interfered with.

Municipal Affairs.

There is prospect of an improvement in the public lighting of Sheffield, thanks to the Corporation's appointment of a lighting engineer. The official in question, Mr. F. Colquhoun, who comes from Glasgow, has now taken up his duties, and has expressed the opinion that there is room for improvement in the lighting of the streets. He has pointed out that in Sheffield the public lighting costs £70,000 a year for an area of 23,000 acres, while Glasgow spends £160,000 on 19,000 acres. Rotherham Borough Council has decided to erect a new bridge over the river Rother in Sheffield-road, and has accepted the tender of Messrs. Longden and Sons, of Sheffield, to carry out the work for £14,234. A second scheme is the construction of Hill-street bridge at a cost of £5281, of which the Ministry of Transport will grant 50 per cent. after deducting £600 to be paid by the railway company.

NORTH OF ENGLAND.

(From our own Correspondent.)

Iron and Steel Export Trade Improving.

A GRATIFYING feature in trade circles in the North of England, as revealed in the return of exports of pig iron and manufactured iron and steel from the Cleveland district during April, is the recapture of foreign markets, which had been lost for some time past. The difficulties confronting producers in competing for foreign business appear to have been largely overcome, and the position has been so radically altered that in most European markets Cleveland iron is now the cheapest on offer. Consequently the April exports of pig iron from Cleveland to the Continent were the best for any month since April of last year. Coastwise shipments were also rather better, and the aggregate shipments of pig iron to home and foreign ports totalled 48,238 tons, compared with only 32,427 tons in March. To Scotland, the shipments totalled 11,962 tons, as against 11,573 tons in March, and although for the first month this year no pig iron crossed the Atlantic from Cleveland, increased quantities went to all European destinations, Germany's total being 8831 tons, and Belgium's 6775 tons. The outstanding feature of the steel exports was the enormous total despatched to India, Ceylon, and Burmah. An export of 25,610 tons represented nearly half of the total, and more than doubled the March figure. To this increase was entirely due the advance in the manufactured iron and steel exports from 48,010 tons in March to 56,368 tons in April.

Cleveland Iron Trade.

The Cleveland pig iron market has assumed a quieter aspect during the past few days, but it is probably no more than a temporary phase, and traders are confident of improved conditions in the very near future. There is still a considerable volume of inquiry, but definite business comes slowly to hand, and consequently the market is a little weaker. It must be remembered that a month ago a very large business was placed with Cleveland ironmasters, and this iron has yet to be digested before consumers need to come on the market for more. Then, again, the elections in Germany and the approach of the elections in France are a disturbing factor so far as continental business is concerned. But it would not take a great deal of business to stiffen up the market all round. There is now very little iron in stock, makers have little more than their current make for sale, and any real expansion in trade would quickly absorb all the iron in sight. It is confidently believed that a new buying movement may not be long delayed, as Cleveland iron at current rates is an attractive proposition to both home and foreign consumers. It can now be delivered into Lancashire in competition with Midland iron; it is rather cheaper than Scottish foundry iron delivered to the Scottish works, and it is underselling French iron on the Continent. Thus makers of Cleveland iron have a wide field for the disposal of their output. No. 3 G.M.B. Cleveland pig iron is quoted 91s. 6d. to 92s., No. 4 foundry, 91s.; and No. 4 forge, 90s. No. 1 is still scare and firm at 97s. 6d.

Hematite Pig Iron.

The hematite makers report rather better business both with home consumers and also for shipment to French and German ports. In some cases makers refuse to sell East Coast mixed numbers below 99s., but orders can still be placed at 98s. 6d. per ton.

Ironmaking Materials.

The foreign ore trade is still in a lifeless condition, with 23s. 6d. per ton c.i.f., Tees, a purely nominal figure for best Rubio ore. The coke market is also weak. There is very little export demand, and prices vary considerably. Some Durham coke makers refuse to cut below 30s. for good medium furnace qualities delivered at the works, but it is stated by consumers that they can buy as low as 27s. 6d. per ton.

Manufactured Iron and Steel.

There appears to be more movement in the manufactured iron and steel trade. With the present rate of exchange British makers can successfully compete with French and German producers, and are getting a fair share of export business, whilst there is now a relatively small amount of cheap foreign blooms and billets offered in British markets. The shipbuilding industry generally is still depressed, but one or two orders have been placed with Northern yards lately, and the outlook for this branch of the trade is slightly more encouraging. Prices are unaltered.

The Coal Trade.

The recent reduction in Northern coal prices has caused many continental consumers to come forward with inquiries, and several firm offers are circulating; but the idea abroad is that the market is much easier than operators on this side consider it, and consequently all business offered is at substantially lower values than the prices asked here. The business offered shows a much increased volume, and this tends to steady the ideas of producers who consider that there is considerable business to place, and that it is simply held back in order to force lower prices. The fact remains, however, that business is not coming forward to the extent expected. There are still a few sanguine people about who think that the fall in trade is too rapid to be permanent; but, on the other hand, there is the fact that the Germans are enforcing, as far as possible, the consumption of Westphalian coals on the railways, and the French and Belgians are also making every endeavour to limit the import of British coals in the effort to improve the exchange value; but the biggest disappointment is the slow demand coming from Sweden, Finland, &c., now that navigation is opening. For the first half of this month values depend on individual positions, and buyers able to take prompt deliveries can secure concessions. For middle and later in the month current prices are quoted, but fail to attract positive business. There is little movement in the coke trade. Stocks are heavy, and in the absence of pressure, prices show a weakening tendency.

Iron and Steel Imports.

Statistics presented at a meeting of the Tees Conservancy Commission this week showed that during April 5969 tons of pig iron were imported from abroad to the Tees, as compared with 1612 tons in March and 4435 tons in February. For the past six months imports had totalled 13,707 tons, against 4215 tons a year ago.

While the importation of crude sheet bars, &c., in April showed a decrease of about 1000 tons compared with March, the figure of 9876 tons was well above the average of the preceding months, but there was little variation in the importation of plates, angles, &c.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding—Clyde Outlook Improving.

CERTAIN circumstances have combined to produce a somewhat brighter outlook in the shipbuilding trade on the Clyde. They are; the probable settlement of the wages question by arbitration, the placing of the cruiser contracts, and a number of new mercantile contracts. Furthermore, it is reported that the work produced by the men employed at the yards at present is good. The output during April totalled twenty-one vessels of 34,114 tons aggregate, bringing the total for the year to date, up to fifty-nine vessels of 139,856 tons aggregate, compared with thirty-five vessels of 119,935 tons aggregate in the same period last year. Of the vessels launched during April last three were of 5000 tons or over, the largest of which was the Auditor, cargo steamer, 5500 tons, built for T. and J. Harrison, Limited, Liverpool. Among the smaller craft was the Munshi, train ferry steamer, 900 tons, for the Crown Agents for the Colonies for Nigerian railway service; the Lovat, coasting steamer, 800 tons, for Nova Scotia; the Thalassa, twin-screw yacht, 770 tons and 1000 indicated horse-power, Thames measurement, for Mr. Eugene Higgins, New York; a small cargo steamer for Sydney, N.S.W.; a 500-ton water tank steamer for South America; and a double-ended quadruple-screw ferry steamer of 444 tons for Rio de Janeiro. Included in the list of new orders are the following:—A motor ship, 425ft. in length, to be built by Messrs. Scott's Shipbuilding and Engineering Company, Greenock, for Messrs. Alfred Holt and Co., Liverpool; Messrs. Chas. Connell and Co., Scotstoun, and Messrs. William Hamilton and Co., Port-Glasgow, each to build a turbine steamer of 430ft. for the Brocklebank Line; and Messrs. John Brown and Co., Clydebank, a large motor vessel, the owners of which are not yet made known.

Pig Iron.

The pig iron market continues to show a fairly firm front, though business is still comparatively small. A slightly better inquiry for hematite has been mentioned, but the total amount of the turnover could have little actual effect on the market. The price stated for hematite was £5 2s. 6d. per ton, and the quotations for foundry qualities likewise are unchanged from last week. The tendency, however, is said to be upwards.

Steel and Iron—More Inquiry.

The situation in the steel and iron trades has become a little brighter by virtue of the interest displayed with regard to future transactions. Some forward buying has taken place just lately, and though perhaps not of a particularly extensive nature, yet still of sufficient quantities to warrant a certain measure of hopefulness. Business in steel plates and sections would be very welcome, as these are the slowest departments at present. Sheets are comparatively busy, having booked some fairly good export orders, including the heavier gauges. Structural engineers are again in a better position, chiefly owing to orders placed for railway work. The bar ironworks have fair orders for hoops and strips, but on the whole purchasing is slow, though in this trade also a tendency to buy ahead is becoming more apparent. Up to the present all prices are unchanged for home delivery.

Coal—Continued Weakness.

The coal market has been very idle in all departments during the past week. The export inquiry has been very limited, partly, it is said, owing to German competition. The weakening market, however, is probably the chief reason for the attitude of foreign buyers. All descriptions of fuel are on offer and cheap prices have been quoted by some collieries in order to get their sidings cleared. Little success has attended their efforts, however, and broken time is more general. Foreign shipments have declined further, but the returns are as large as in the preceding week, owing to larger coastwise clearances and more bunkering orders. Total shipments amounted to 231,187 tons, against 230,496 tons in the preceding week and 364,390 tons in the same week last year. The home market is equally stagnant, as many consumers adhere to their policy of working off stocks recently accumulated against the possibility of a strike. For both export and home transactions prices are more or less a matter of arrangement at present.

Miners' Wages.

The accountants' report on the coal mining industry during January and February last, on which the wages for May and June will be based, shows an increase of 2.92 per cent. over the rates governing wages in March and April. This represents an increase of about 1¼d. per day and brings wages in Scotland to 10s. 0½d. per shift. This increase is subject to any alteration that may be made when the findings of the present wages inquiry are announced.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Miners and Their Demands.

MONDAY was Labour Day, and in accordance with arrangement there was no work at the collieries in this district. Instead there were meetings in all the large centres, at which there was the usual flow of oratory on the part of the miners' leaders, who dealt with the demands of the colliery workers and the recent inquiry. One of the leaders made the statement, that if, as the result of the inquiry, something was not done on which they could base negotiations when they met the owners next week, then there would be a serious danger of a breach taking place. It was predicted that anything might happen in the mining industry unless the employers were prepared to come to an agreement that would ensure the men a living wage at least equal to the 1914 standard. Other leaders naturally attacked the capitalists and described the mining industry as in a state of chaos as the result of its being in their hands, while they urged the workmen to press forward their demands for the pooling or unification of the industry. Mr. Hall said that he would have the honour of introducing a Bill into the House of Commons for the nationalisation of the industry.

Coal Trade Outlook.

Last week the coal market appeared to be at its lowest level, and depression was in evidence in all directions, but there has been a slight improvement in the tone since, for the reason that stems for prompt loading have filled up to some extent. Whether this is going to be maintained remains to be seen, as the inquiry from abroad is not by any means active, although the collieries will not sell ahead at the very low prices which have been accepted of late from those buyers who have been able to take immediate delivery and so enable the collieries to provide wagons with which to keep their pits working. Even now the docks are short of sufficient tonnage to keep all the loading appliances employed, and this, of course, means that some collieries must be badly off for orders. Apart from the general outlook and any anxiety that might be caused by the labour position, it looks very much as if the demand for coals is likely to continue on quiet lines, and it is no wonder that the coalowners have decided to revive the group committees formed for the purpose of stabilising prices by means of weekly conferences in order to discuss the situation. These committees, consisting mainly of colliery salesmen, do not fix prices, but by discussing together the conditions, endeavour to assist each other to resist any downward trend in the market. Their services may certainly be required, as it is unpleasant reading to learn that one of the French railways, which in ordinary times comes to this district, has contracted for 300,000 tons of German coals for delivery from now to the end of the year. This is a serious matter, as it is a big loss. Tenders go in next week for the Egyptian State Railways for 150,000 tons of steam coals for shipment from June to December, and there is no doubt that the competition will be very keen for this business, but hopes are entertained that the order will come to this district. The Swedish Railways have purchased about 15,000 tons of best Admiralty large from a local firm for delivery over the remainder of this month and next.

Miners' Wages.

The ascertainment of the proceeds of the coal mining industry for the months of January and February, as disclosed by the certificate of the joint auditors, gives a percentage of 24.97 on the 1915 standard. As the men are entitled to a minimum percentage of 28, the miners' wages will continue on the minimum and there will be no variation in wages until a new agreement is reached.

Coalfield Troubles.

Reference has already been made to the action of the employers, Guest, Keen and Nettlefolds, Limited, in closing three pits in the Dowlais area for economic reasons, affecting about 3000 workmen. Within the past week or so representatives of the workmen and the employers have had interviews with the Minister of Mines, and as a consequence the employers have given their assurance that they would do their utmost to absorb the workmen at other collieries. The hope is entertained that this will be accomplished in six weeks at the latest. Notices terminated at the end of last week in the case of about 700 men engaged in the 5ft. seam of the Risca Colliery belonging to the United National Colliery Company, Limited. This seam, it is stated, is to be closed down, but doubtless the employers will do their utmost to find work for some of the men, at any rate, at their other pits.

Copper Firms Combine.

It is understood that the negotiations have been completed in connection with the proposed amalgamation of two of the leading firms of copper manufacturers in this country. A provisional agreement has been signed between Vivian and Sons, Limited, on the one hand, and Williams, Foster and Co. and Pascoe, Grenfell and Sons, Limited, on the other, and as a consequence a new company will shortly be formed to carry on the amalgamated undertakings. Both firms own extensive works adjoining each other in the Swansea neighbourhood and are large manufacturers of copper, yellow metal and spelter. It is stated that this important amalgamation will mean a big step towards meeting foreign competition.

Current Market.

The general demand keeps comparatively quiet, and for the most part offers made to buyers abroad fail to prove attractive, though they have been cut to the finest limits. Consumers appear to be still holding off in the expectation that values may still further decline; but prices are now practically at the bottom, and certainly collieries are in a slightly better position for prompt shipment than they were a week ago. At the same time, there were as many as twenty-seven idle berths at the various ports in this channel in the early part of this week, which shows that the state of trade is a long way from satisfactory. The holiday in the coalfield on Monday meant a reduction in the output of about 20 per cent. and enabled some of the collieries to ship some of their standing coals and thus provide them with empty wagons; but this, of course, affords only temporary relief. Best Admiralty large is still about 28s. for prompt loading, though some sellers with contract coals are prepared to accept rather less. On the other hand, collieries are indicating an advance of 1s. per ton for supplies for forward shipment, though as yet buyers are not operating ahead. Small coals are rather scarcer on account of the pits not working regularly and so restricting the supplies. Patent fuel and coke show no change. In the anthracite section prices display very little change, except that sized coals are not so steady for early loading, though rubbly culm gives indications of improving.

Steel Workers' Bonuses.

The decision has been come to that all *ex gratia* bonuses paid since February 3rd last to Siemens steel works in South Wales are to be continued for a further period of three months, viz., to August 2nd. The scale of wages remains unaltered in accordance with the recent ascertainment.

Catalogues.

SKEFKO BALL BEARING COMPANY, Limited, Luton.—New general catalogue.

THE PUBLICITY CLUB OF LONDON.—Pamphlet on the business value of Publicity Clubs.

J. STONE AND CO., Limited, Deptford, S.E. 14.—Leaflet on the Stone-Pollock scuttle clip.

HENRY WELLS OIL COMPANY, 11, Haymarket, S.W. 1.—Pamphlet, germ process motoils.

C. ISLER AND CO., Limited, Bear-lane, Southwark, S.E. 1.—Leaflet on artesian bored tube wells.

O. N. BECK, 11, Queen Victoria-street, E.C. 4.—Pamphlet on the Monarch centrifugal oil purifier.

NORTON COMPANY, Worcester, Mass., U.S.A.—Leaflet on Norton floors, durable, slip-proof, and quiet.

HICK, HARGREAVES AND CO., Limited, Soho Ironworks, Bolton, England.—Catalogue on steam engines.

UNDERFEED STOKER COMPANY, Limited, Aldwych House, Aldwych, W.C. 2.—Pamphlet on the Usco air heater.

BRITTAIN'S ELECTRIC MOTOR COMPANY, 110, Cannon-street, London, E.C. 4.—Pamphlet on "Brittain's" electric motors.

ERNEST WEST AND BENYON, Limited, 82, Belvedere-road, S.E. 1.—List No. 6, on ice-making and refrigerating machinery.

CAPT. H. T. BARNETT, M.I.E.E., 12, Whittington Chambers, King's-road, Southsea.—Pamphlet on up-to-date gramophone tips.

COWLISHAW-WALKER AND COMPANY (1920), Limited, Etruria, Stoke-on-Trent.—Pamphlet on "out-put" coal cutters, model "IMP II."

ROYLES, Limited, Irlam, near Manchester.—Leaflet wherein the Row patented tube is described in the many productions of Messrs. Royles.

MAIN ROPEWAYS, Limited, 47, Victoria-street, S.W. 1.—Illustrated pamphlet on the mechanical handling and transportation of materials.

THE MELBOURNE TECHNICAL SCHOOL. THE WORKING MEN'S COLLEGE (Incorporated), Melbourne, Australia.—A copy of the prospectus for 1924.

AABACAS ENGINEERING COMPANY, Limited, Aabacas House, 10, Canning-place, Liverpool.—Leaflet P.B.1 on the Aabacas electric pulley blocks.

MANLOVE, ALLIOTT AND CO., Limited, Bloomsgrove Works, Nottingham.—Illustrated list No. 5574, on machines for the chemical and allied trades.

SZERELMEY, Limited, Rotherhithe New-road, London, S.E. 16.—Catalogue on the treatment of damp walls and stone decay by the firm's process.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE death is announced of Mr. S. Utting, of Grosvenor Mansions, 82, Victoria-street, London, S.W. 1.

WE learn with regret of the death of Mr. Olaf Kjelsburg, the chief constructing engineer of the Swiss Locomotive and Machine Works, who died at Winterthur on April 26th.

WE are asked to state that Mr. Thos. Vickers, late of the British Cast Iron Research Association, has commenced in private practice as a foundry consulting engineer with offices at 14, New-street, Birmingham.

ROADS AND PUBLIC WORKS, Limited, of Dartmouth-street, Westminster, London, S.W., inform us that Mr. W. D. Harding, A.M. Inst. C.E., ceased to act as chief engineer and a director of the company as from May 1st.

NEWTON BROTHERS (DERBY), Limited, inform us that they have appointed Mr. J. F. Bradshaw, late works manager of Messrs. J. Stirk and Sons, Halifax, a member of their staff in connection with the Newton Derby patented reversing drive.

REAVELL AND CO., Limited, of Ipswich, ask us to state that, the better to deal with their business in the Manchester area, they have opened an office at 49 and 50, Imperial-buildings, Oxford-street, Manchester. It will be in charge of Mr. S. N. Howe.

MR. H. J. DEANE and Major F. M. DU-PLAT-TAYLOR, MM. Inst. C.E., MM. I. Mech. E., inform us that, having severed their connection with the Port of London Authority, they have taken an office at 36, Victoria-street, Westminster, where they purpose practising as consulting civil and mechanical engineers.

THE FOSTER ENGINEERING COMPANY, Limited, of Morden Works, Wimbledon, S.W. 19, informs us that it has transferred its branch office from 67, Waterloo-street to 27, Blythswood-square, Glasgow (telephone, Douglas 324), and that the office is under the management of Mr. W. Yuille, late of Messrs. John T. Cartwright.

MR. R. A. LOWER, who has been sales engineer to the Norwich Corporation Electricity Department since 1911, advises us that he has been appointed chief sales engineer to the Yorkshire Electric Power Company, and that he will take up his appointment on June 2nd next, when his office will be situated at 36, Park-place, Leeds.

CONTRACTS.

AN order has been placed with Vickers Limited, Barrow-in-Furness, by the Warren Line, Limited (Messrs. Furness, Withy and Co., managers), for the construction of a passenger and cargo steamer, designed specially for the Liverpool–Canada and Newfoundland passenger service. The principal dimensions of the vessel will be as follows:—405ft. by 54ft. 6in. by 34ft. 4in. and the deadweight about 7030 tons. There will be accommodation for 100 first-class and 80 third-class passengers.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	17/6 to 26/-
(1) Spanish	23/-
(1) N. African	23/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	23,6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	5 2 6	—
No. 1 Foundry	5 5 0	—
No. 3 Foundry	5 0 0	—
N.E. Coast—		
Hematite Mixed Nos.	4 19 0	4 19 0
No. 1	5 0 0	5 0 0
Cleveland—		
No. 1	4 17 6	4 17 6
Silicious Iron	4 17 6	4 17 6
No. 3 G.M.B.	4 12 0	4 12 0
No. 4 Foundry	4 11 0	4 11 0
No. 4 Forge	4 10 0	4 10 0
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	9 2 6	—
North Staffs. Forge	4 7 6 to 4 10 0	
" " Foundry	4 15 0	—
(3) Northampton—		
Foundry No. 3	4 12 6	—
" Forge	4 5 0	—
(3) Derbyshire—		
No. 3 Foundry	4 15 0	—
Forge	4 7 6	—
(3) Lincolnshire—		
No. 3 Foundry	4 14 6	—
No. 4 Forge	4 13 0	—
Basic	4 11 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 12 6 (a) / 5 17 6 (b)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	12 10 0	—
Best "	—	—
N.E. Coast—		
Common Bars	12 10 0	—
Lancs.—		
Crown Bars	13 0 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	14 15 0
S. Yorks.—		
Crown Bars	13 0 0	—
Best "	13 10 0	—
Hoops	14 10 0	—
Midlands—		
Crown Bars	13 0 0	—
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	12 0 0	
Gas Tube Strip	13 5 0 to 13 7 6	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	13 10 0	—
Ship Plates, ½in. and up	10 5 0	—
Sections	10 0 0	—
Steel Sheets, 5/16in. to ½in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	17 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	10 5 0	—
Angles	10 0 0	—
Boiler Plates	13 10 0	—
Joists	10 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	10 5 0	—
Soft Billets	9 0 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	9 5 0†	—
Light "	9 10 0 to 10 0 0†	
Billets	8 10 0 to 12 0 0†	
Manchester—		
Bars (Round)	10 5 0 to 10 15 0	
" (others)	10 0 0 to 10 2 6	
Hoops (Best)	15 5 0	15 0 0
" (Soft Steel)	13 15 0	13 10 0
Plates	10 0 0 to 10 5 0	—
" (Lancs. Boiler)	13 10 0	—
Sheffield—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	10 5 0	—
Intermediate Basic	10 0 0	—
Soft Basic	8 15 0	—
Hoops	12 10 0 to 13 0 0	
Soft Wire Rods	11 0 0 to 11 10 0	
Midlands—		
Small Rolled Bars	10 5 0 to 10 10 0	
Billets and Sheet-bars	8 5 0 to 8 10 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	17 5 0 to 17 10 0	
Angles	9 17 6 to 10 0 0	
Joists	9 17 6 to 10 0 0	
Tees	10 17 6 to 11 0 0	
Bridge and Tank Plates	10 10 0	—
Boiler Plates	14 0 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	24/- to 24/3
Block Tin (cash)	233 10 0
" (three months)	233 5 0
Copper (cash)	63 7 6
" (three months)	64 5 0
Spanish Lead (cash)	28 15 0
" (three months)	27 12 6
Spelter (cash)	30 2 6
" (three months)	30 7 6
Manchester—	
Copper, Best Selected Ingots	68 5 0
" Electrolytic	69 10 0
" Strong Sheets	96 0 0
" Tubes (Basis price)	0 1 1½
Brass Tubes (Basis price)	0 1 0½
" Condenser	0 1 2½
Lead, English	31 0 0
" Foreign	29 0 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8½ per lb.	
Ferro Tungsten	1/4½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	10/6
" 6 p.c. to 8 p.c. "	£23 10 0	8/-
" 8 p.c. to 10 p.c. "	£22 0 0	8/-
" Specially Refined		
" Max. 2 p.c. carbon	£42 10 0	16/-
" " 1 p.c. "	£51 0 0	17/6
" " 0.75 p.c. carbon	£75 0 0	20/-
" carbon free	1/5 per lb.	
Metallic Chromium	4/2 per lb.	
Ferro Manganese (per ton)	£17 for home, £17 for export	
" Silicon, 45 p.c. to 50 p.c.	£11 10 0	scale 5/- per unit
" " 75 p.c.	£18 0 0	scale 6/- per unit
" Vanadium	19/9 per lb.	
" Molybdenum	8/6 per lb.	
" Titanium (carbon free)	1/3 per lb.	
Nickel (per ton)	£135	
Cobalt	10/6 per lb.	
Aluminium (per ton)	£82 to £100 (British Official.)	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	21/-
" " Ell	22/6
" " Splint	23/6 to 25/6
" " Trebles	22/6
" " Doubles	21/6
" " Singles	18/6
Ayrshire—	
(f.o.b. Ports)—Steam	21/-
" " Splint	23/6
" " Trebles	22/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	19/6 to 22,9
Screened Navigation	28/-
Trebles	23/6
Doubles	22/6
Singles	18/-
Lothians—	
(f.o.b. Leith)—Best Steam	22/-
Secondary Steam	20/6
Trebles	23/-
Doubles	22/-
Singles	18/-

ENGLAND.

	Export.
(8) N.W. Coast—	
Steams	32/-
Household	49/- to 59/-
Coke	38/6
Northumberland—	
Best Steams	23/6
Second Steams	22/- to 22/6
Steam Smalls	15/- to 15/6
Unscreened	20/- to 21/-
Household	26/- to 28/-
Durham—	
Best Gas	23/6 to 24/-
Second	21/-
Household	26/- to 28/-
Foundry Coke	28/- to 28/-

Sheffield—	Inland.	
Best Hand-picked Branch	36/- to 39/-	—
Barnsley Best Silkstone	34/- to 36/-	—
Derbyshire Best Brights	31/- to 35/-	—
" " House	27/- to 29/-	—
" " Large Nuts	27/- to 28/-	—
" " Small "	20/6 to 23/-	—
Yorkshire Hards	27/- to 30/-	—
Derbyshire "	25/- to 28/-	—
Rough Slacks	12/6 to 15/6	—
Nutty "	12/- to 14/-	—
Smalls	8/- to 10/-	—
Blast-furnace Coke (Inland) *		
" " (Export)	f.o.b.	31/6

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	27/6 to 28/6
Second " "	26/6 to 27/6
Best Dry Large	27/- to 27/6
Ordinary Dry Large	25/- to 26/-
Best Black Vein Large	27/- to 27/6
Western Valley "	26/6 to 27/-
Best Eastern Valley Large	25/6 to 26/6
Ordinary " "	25/- to 26/-
Best Steam Smalls	18/- to 18/6
Ordinary "	17/- to 18/-
Washed Nuts	25/- to 27/-
No. 3 Rhondda Large	28/- to 29/-
" " Smalls	23/- to 24/-
No. 2 " Large	24/6 to 25/6
" " Through	21/- to 23/-
" " Smalls	16/- to 17/-
Coke (export)	55/- to 57/6
Patent Fuel	29/- to 30/-
Pitwood (ex ship)	25/- to 26/-
Swansea—	
Anthracite Coals:	
Best Big Vein Large	42/6 to 45/-
Seconds	37/6 to 40/-
Red Vein	32/6 to 35/-
Machine-made Cobbles	47/6 to 52/6
Nuts	44/- to 46/-
Beans	46/- to 47/-
Peas	27/- to 29/-
Breaker Duff	12/- to 12/6
Rubbly Culm	16/- to 16/6
Steam Coals:	
Large	24/- to 26/-
Seconds	22/- to 24/-
Smalls	15/- to 18/-
Cargo Through	18/- to 22/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

* Blast-furnace Coke (Inland): Special Price for Ironworks 24/-, open market 29/-. † Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Protection.

THE proposal to suppress certain of the McKenna duties on goods imported into Britain from countries with a depreciated currency has given rise to a good deal of satisfaction here, especially amongst the motor car firms, which expect to do a considerably increasing business. One of the leading makers who recently visited England with the idea of examining the possibility of equipping a motor car factory in order to escape those duties has evidently given up the idea of manufacturing in a market where he has now reason to hope that he will be able to export vehicles under specially favourable conditions, and he states that he expects to increase his consignment of cars to England from twenty to fifty a day. The suggested removal of the duties is regarded by the French as the inauguration of a free trade policy, which will certainly have the effect of developing business in French goods, and one authority declares that it will help to stabilise the franc, which means that the value of the pound sterling will have to come down to meet the appreciation of the franc. Unfortunately, there appears to be little hope of any reduction of import duties on French goods being followed by concessions from this country. It is true that it has been found necessary to lower import duties on certain produce and goods, such as grain and agricultural machinery, but in a general way the tendency is to ensure adequate protection for home manufactures, and it is certain that the fiscal duties will not be reduced to any appreciable extent unless the country can secure material advantages in return. It is even proposed to carry protection to the extent of placing duties on many descriptions of raw material from abroad, with a view of encouraging its production in the Colonies. It is claimed that the Colonies can supply nearly all the raw material required by the Mother Country, but there is no hope of largely increasing the colonial production unless capital is encouraged to embark upon the development of the resources overseas by the certainty that its enterprise will not be ruined by foreign competition. As, however, competition is necessary to keep down the prices of raw material, without which the manufacturing industries would be unable to compete even in their own market, it is difficult to see how a protectionist policy can be adopted for the benefit of colonial industries that are still in a very early stage of development.

Sugar Machinery.

Manufacturers of sugar-making machinery have for some time past completed the work of reconstructing the sugar factories in the devastated regions, and they now find themselves with little work on account of the almost total loss of the foreign trade. The business they did before the war in Cuba and South America has passed into the hands of United States firms, and efforts to get it back have failed, despite the advantages French makers would appear to have in the more favourable exchange rate. In the absence of orders from abroad, it is hoped to secure new business by the creation of a beet sugar industry in Algeria, where a Commission has been investigating the chances of successfully growing beet. For some years past, experiments have shown that beet of good sugar content can be grown in Algeria. The cost of fuel is a serious drawback, but on the other hand labour is very cheap, so that the cost of the sugar production is expected to be lower than it is in France.

Alcohol Monopoly.

As it is important to control the production of alcohol, in view of the necessity of procuring the greatest possible quantity in time of national emergency, the State was invested two years ago with a monopoly of the purchase and distribution of the spirit distilled from other products than grapes and fruit, which was alone authorised for human consumption. All other alcohol was to be employed for industrial purposes. A maximum production cannot be assured unless an outlet is found for the spirit, and the only practically unlimited opening is provided by the substitution of alcohol for petrol as a motor fuel. The object of the State, therefore, was to adapt prices to the purposes for which the alcohol would be used, whereby it would be possible to realise sufficient profit on some applications to allow of the spirit being sold as a motor fuel at a price not exceeding that of petrol. Finally, the Government was obliged to secure the passing of a law compelling importers of mineral spirit to purchase from the State a quantity of alcohol equal to one-tenth the amount of petrol or benzol purchased abroad. The alcohol was to be mixed with petrol in that proportion and sold as a "national motor fuel." This would have absorbed the total production of power alcohol in the country. Unfortunately, it is found that the mixture is only satisfactory when the alcohol is nearly absolute, and the rectification of the spirit necessitates further expense, which entails considerable loss to the State. The Government is therefore by no means anxious to fix the price at which it will undertake to purchase the present year's supply. The growers declare that they will not sow any beet for alcohol unless the Government undertakes immediately to pay a price that will ensure the same profits as are obtained by those who supply beet to the sugar factories.

A Remarkable Flight.

The aeroplane with which Lieut. Pelletier d'Oisy is making his remarkable flight from Paris to Japan is an all-metal Breguet machine, with a Lorraine-Dietrich 300 horse-power engine of a type specially designed for the Army, and having a speed that renders it suitable for scouting purposes. The length of the machine is 9 m., and its total width 14.50 m. The weight is 1200 kilos. It is designed to carry a load of 900 kilos., but with the extra supplies of petrol carried, the total load at the beginning of each stage was 1200 kilos. The load now carried allows of non-stop flights more than double the distance that was possible a year ago.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

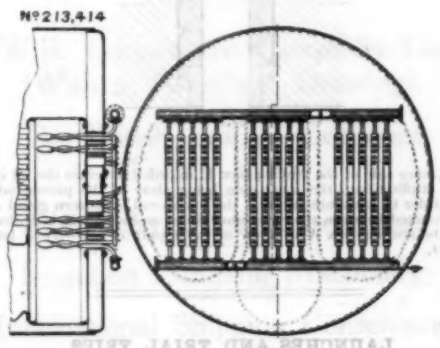
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

213,414. March 12th, 1923.—IMPROVEMENTS IN STEAM SUPERHEATERS FOR SCOTCH MARINE BOILERS, Edward Arthur Geoghegan and Milton Kramer, both of 350, Madison-avenue, New York.

This invention will readily be understood from the drawing. In the combustion chamber of a Scotch marine boiler, superheater tubes are arranged as shown. The flames and heated fire gases from the furnace flue pass upwardly to the flues. The return bend superheater tubes are arranged in vertical series by means

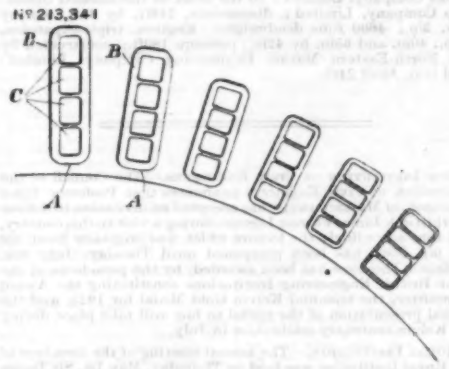


of vertical headers. These headers communicate with upper and lower horizontal intake and outlet headers. Both the horizontal and vertical headers are provided with transverse partitions, so that steam entering the inlet header travels through the first group of vertical headers before it enters the succeeding group of vertical headers. Each of the vertical headers is provided with partition walls, which causes the steam to travel through each of the return bend superheater tubes before it enters the succeeding tube.—*April 3rd*, 1924.

DYNAMOS AND MOTORS.

213,341. December 30th, 1922.—IMPROVEMENTS IN AND RELATING TO DYNAMO-ELECTRIC MACHINES, Sir Charles Parsons and Jessel Rosen, of Heaton Works, Newcastle-on-Tyne.

The drawing shows one method of carrying out the invention. The stator is provided with slots A in which the conductors C are placed. The dimensions of these slots A are varied so that the adjacent slots increase in depth as the potential of the conductors increases, the width of the slots remaining constant. Each slot is provided with four conductors, the area of the conductors being the same in all the slots. The cross-sectional area

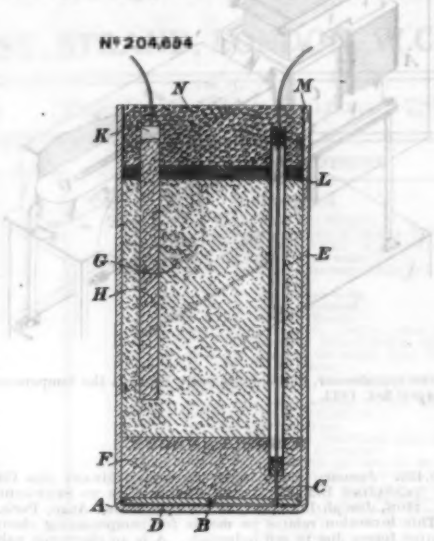


of the slots is thus graded in relation to the cross-sectional area of the conductors contained therein. The four conductors C in the first slot A are all of the same dimensions, but are of different dimensions from those in the other slots. The area of the conductors is kept constant, but their dimensions are varied from slot to slot, so as to fit into the different sized slots to the best advantage. This increase in the area of the slot allows for the accommodation of extra insulation B. Six slots have been taken as an example, but any number can be employed.—*March 31st*, 1924.

BATTERIES AND ACCUMULATORS.

204,694. September 27th, 1922.—IMPROVEMENTS RELATING TO ELECTRIC CELLS, *Metropolitan-Vickers Electrical Company, 4, Central-buildings, Westminster.*

A cell constructed in accordance with the invention is provided with a glass container, which obviates the necessity for insulation, such as wax paper, between adjacent cells of a battery. It also makes possible the use of amalgamated zinc in the cell, thereby preventing local action and the generation of gases because of impurities in the zinc. A cheap grade of zinc may be utilised and only a relatively small quantity is necessary. Various other advantages are also claimed for the cell. In the bottom of the container there is placed a metal plate A consisting of a heavily amalgamated sheet of zinc having a number of openings B. A copper terminal wire C, the lower end of which is amalgamated, is inserted in the opening and is bent so as to make good contact with the plate. A layer or coating D of copper may be provided on the lower side of the plate A before amalgamating in order to make more certain contact between the plate and the terminal wire. A glass tube E surrounds the terminal wire, the lower end being sealed with starch paste. The electrolyte F consists of a starch paste mixture containing about 40 parts starch, 30 parts ammonium chloride, 20 parts zinc chloride, and 26 parts water. The mixture is poured into the container until a layer of sufficient thickness has been formed to set and become solid. The depolarising mixture G consists of about 40 parts manganese dioxide, 16 parts graphite, 3 parts ammonium chloride, 1.2 parts zinc chloride, and sufficient water to make a stiff paste. The depolariser is placed upon the electrolyte in direct contact with it. A carbon rod H, which has been impregnated with paraffin, projects into the depolariser G and has a

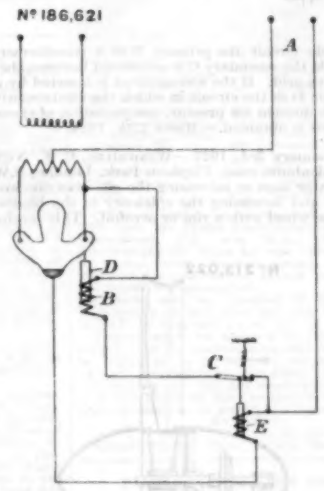


metal cap K on the upper end. The cap K may be formed in any desired manner, but it has been found that spraying copper on the end of the carbon rod provides a permanent structure which is electrically efficient. A terminal wire is secured to the cap in any suitable manner. A layer L of separating material, such as paper, is placed on the depolariser and a thin layer of adhesive wax M is spread on the walls of the container above the paper layer. Ordinary sealing wax N is poured into the top of the container to fill it and to seal the cell from the atmosphere.—*April 3rd*, 1924.

TELEGRAPHS AND TELEPHONES.

186,621. October 1st, 1922.—APPARATUS FOR THE AUTOMATIC SWITCHING ON AND OFF OF MERCURY VAPOUR RECTIFIERS, Coenraad Alfred Augustus Haighton, of 11a, Juliana van Stolbergplein, The Hague, Holland.

According to this invention, the rectifier is tilted before the arc is started by means of a solenoid, which is connected in parallel with one of the branches of the rectifier, and it is excited by an alternating current as soon as the consuming apparatus, such, for example, as telephone apparatus, is switched on. If the consuming apparatus is connected to the continuous current



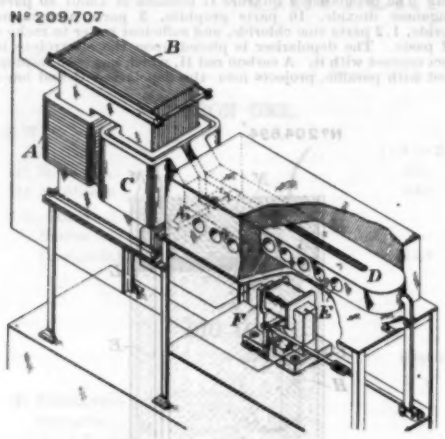
circuit A, an alternating current from the secondary winding of the transformer flows first through the solenoid B, the switch C and the consuming apparatus. The core D is attracted, the rectifier tilted, and the arc is consequently established. As soon as a continuous current is given off, the magnet E is excited and the switch C is opened. The magnet B loses its excitation, and the rectifier is returned to its original position under the action of the spring or counterweight. If the consuming apparatus is once more switched off, the switch C is again closed and the rectifier takes up its original position.
—*March 31st*, 1924.

FURNACES.

209,707. January 13th, 1923.—IMPROVEMENTS IN HEAT CONTROL FOR ELECTRIC INDUCTION FURNACES, William Elsdon-Dew, Leslie Pryce, and Leon Byron Woodworth, all of Corner House, Commissioner-street, Johannesburg, Transvaal.

In the heating of rock drills and other articles in quantities, preparatory to forging or hardening, it is desirable to be able to leave the articles in the furnace with the assurance that they will attain the correct temperature without danger of overheating, and the principal object of this invention is to provide an effective means for temperature control. Another object is to provide for the ready attainment of different temperatures, such as a forging temperature and a hardening temperature. The primary winding of the transformer of the furnace is shown at A and the core at B. The part C of the secondary winding is of relatively high conductivity, and the portion D of relatively low conductivity. It becomes heated by the heavy current induced,

and is utilised for heating the rock drills and other articles. The holes E receive rock drills. The expansion of the part D is made to actuate a device F which regulates the primary current

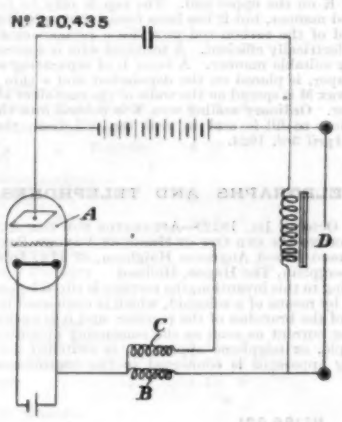


of the transformer, and consequently controls the temperature. —*April 3rd*, 1923.

MISCELLANEOUS.

210,435. January 23rd, 1924.—IMPROVED MEANS FOR COMPENSATING ELECTROMOTIVE FORCES DUE TO SELF-INDUCTION, Joseph Bethenod, of 15, Rue Michel Ange, Paris.

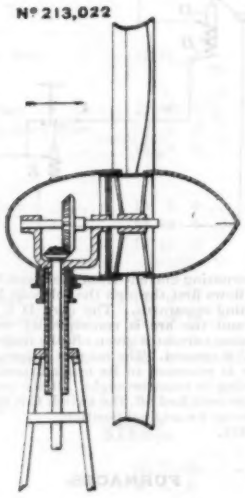
This invention relates to means for compensating electromotive forces due to self-induction. A is an electronic valve.



In the anode circuit the primary B of a transformer is connected, while the secondary C is connected between the cathode and the valve grid. If the arrangement is inserted by means of the terminals D in the circuit in which the electromotive forces due to self-induction are present, compensation of these electromotive forces is obtained.—*March 27th*, 1924.

213,022. January 3rd, 1923.—WINDMILLS, C. F. Nightingale, 14, Rodenhurst-road, Clapham Park, London, S.W. 4.

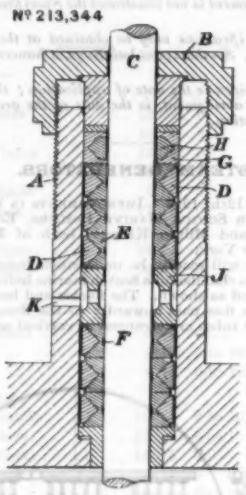
The inventor aims at increasing the effective disc area of the wind wheel and increasing the efficiency of the blades by surrounding the wheel with a rim or aerofoil. This aerofoil is of a



width not more than twice that of the vane tips of the wind wheel, the maximum camber of the aerofoil being arranged at a distance of from 0.3 to 0.4 of its chord from the inlet end. It is suggested that such a wheel does not require a tail to keep it in the wind.—*March 27th*, 1924.

213,344. January 1st, 1923.—IMPROVEMENTS RELATING TO PACKINGS FOR THE GLANDS OF PISTON-RODS AND THE LIKE, Sir Alfred Seale Haslam, Derby.

The drawing shows a section of a packing made in accordance with this invention. A is a stuffing-box having a screw cap B by means of which the packing is retained in the stuffing-box. The packing consists of a number of steel carrier rings D, on which are cast soft metal rings E, which are concave in section. The concavities receive the triangular part of the steel rings, and from a compound ring of approximately rectangular section. When assembled together, the soft metal rings are in contact with each other. The inner sides of the soft metal rings are in contact with the piston-rod, and are provided with circumferential oil grooves F. The last ring in the stuffing-box is so formed that the soft metal ring G is mounted on the hard metal ring H in such a manner that the soft metal ring G is in contact with



the inner side of the stuffing-box A, in order to retain the oil in the stuffing-box, the inner side being clear of the piston-rod. In order to lubricate and seal the piston-rod, a lantern gland J is inserted between the compound rings, and a hole K is drilled in the stuffing-box A to allow of the supply of oil.—*April 1st*, 1924.

LAUNCHES AND TRIAL TRIPS.

PADDINGTON, steel screw steamer; built by Craig, Taylor and Co., Limited, to the order of H. Harrison (Shipping), Limited; dimensions, 254ft. 9in. by 36ft. 9in. by 18ft. 1in. Engines, 17½in., 29in., and 48in. by 33in., pressure 180 lb.; constructed by the North-Eastern Marine Engineering Company, Limited; launch, April 17th.

ALGERIAN, single-screw steamer; built by Barclay, Curle and Co., Limited; to the order of the Ellerman Lines, Limited; dimensions, 304ft. 6in. by 43ft. 6in. by 23ft.; 3100 gross tonnage. Engines, single-screw triple-expansion; constructed by the builders; launch, April 23rd.

GLENBANK, motor vessel; built by Harland and Wolff, Limited; to the order of Andrew Weir and Co., Limited; dimensions, 434ft. by 53ft. 9in. by 37ft.; 5200 gross tonnage. Engines, two sets of six-cylinder Diesel; constructed by the builders; launch, April 23rd.

ATLANTIDA, passenger steamer; built by Workman, Clark and Co., Limited; to the order of the Standard Fruit and Steamship Company; dimensions, 365ft. long by 50ft. beam. Engines, four crank triple-expansion; constructed by the builders; launch, April 24th.

HEWORTH, steamer; built by Irvine's Shipbuilding and Dry Docks Company, Limited; to the order of the Burnett Steamship Company, Limited; dimensions, 348ft. by 44ft. 6in. by 24ft. 3in.; 4600 tons deadweight. Engines, triple-expansion, 24in., 40in. and 65in. by 42in., pressure 180ft.; constructed by the North-Eastern Marine Engineering Company, Limited; trial trip, April 24th.

THE INSTITUTION OF CIVIL ENGINEERS.—The Council of the Institution of Civil Engineers announces that Professor Elihu Thomson, of Massachusetts, has accepted an invitation to deliver the thirtieth James Forrest Lecture during a visit to this country, and that accordingly the lecture which was originally fixed for the 6th inst., has been postponed until Tuesday, July 8th. Professor Thomson has been awarded, by the presidents of the eight British Engineering Institutions constituting the Award Committee, the triennial Kelvin Gold Medal for 1923, and the formal presentation of the medal to him will take place during the Kelvin centenary celebration in July.

ROYAL INSTITUTION.—The annual meeting of the members of the Royal Institution was held on Thursday, May 1st, Sir James Crichton-Browne, treasurer and vice-president, in the chair. The annual report of the Committee of Visitors for the year 1923, testifying to the continued prosperity and efficient management of the Institution, and the report of the Davy Faraday Research Laboratory Committee, were read. Fifty-three new members were elected during the year and sixty-three lectures and eighteen evening discourses were delivered. The books and pamphlets presented amounted to about 154 volumes, making, with 480 volumes (including periodicals bound) purchased by the managers, a total of 634 volumes added to the library in the year. Thanks were voted to the president, treasurer and secretary, to the Committees of Managers and Visitors, and to the professors for their valuable services to the Institution during the past year. The following gentlemen were unanimously elected as officers for the ensuing year:—President: The Duke of Northumberland. Treasurer: Sir James Crichton-Browne. Secretary: Sir Arthur Keith. Managers: The Right Hon. Lord Blanesburgh, Sidney G. Brown, John Mitchell Bruce, Ernest Clarke, John Ambrose Fleming, Sir Robert Hadfield, Sir Alexander C. Mackenzie, the Right Hon. Sir Alfred Mond, Sir Ernest Moon, Saxton W. A. Noble, the Hon. Sir Charles Parsons, Sir Edward Pollock, Lord Rayleigh, Sir Robert Robertson, Sir Alfred Yarrow. Visitors: Sir Harry Baldwin, Alfred Carpmael, Ernest George Coker, Edward Dent, Frederick H. Glew, William J. Gow, W. E. Lawson Johnston, Vincent Warren Low, Ronald Malcolm, Percy St. Clair Matthey, Charles H. Merz, W. Rushton Parker, Major C. E. S. Phillips, Hugh Munro Ross, and John Tennant. A general meeting of the members of the Institution was held on Monday afternoon last, May 5th, Sir James Crichton-Browne, treasurer and vice-president, in the chair. Mr. James D. Hamilton Dickson, Mr. Frank Elmore, Dr. Wilfred Harris, Dr. David Heron, Mr. Austin Y. Hoy, Sir Frederick Keeble, Lady Keeble, Mr. C. L. Long, Mr. Ralph Lucas, Mr. E. K. Maxwell, Dr. David Roxburgh, Lieut. A. S. D. Ryder, Mr. F. E. Smith, Mr. Herbert Spencer, Dr. E. H. Starling were elected members.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF AERONAUTICAL ENGINEERS.—The Engineers Club, Coventry-street, London, W. 1. Informal discussion on "The Future of Aviation in Britain," by Captain W. H. Sayers. 6.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Paper, "Irrigation Pumping Machinery (Gezira Scheme), Sudan," by Mr. R. W. Allen. 6 p.m.

IRON AND STEEL INSTITUTE.—Institution of Civil Engineers, Great George-street, London, S.W. 1. Annual meetings. For programme see page 395. 10.30 a.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, Westminster, London, S.W. 1. Paper, "Methods of Purifying Water and Sewage," by F. W. Follett. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, London, W. 1. Discourse, "The Forces which Lift Aeroplanes," by Professor V. F. K. Bjerknes. 9 p.m.

MONDAY, MAY 12TH.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's-gate, London, S.W. 1. Lecture, "The Makers and Making of Our Modern Navy," by Engineer-Captain E. C. Smith, R.N. 7 p.m.

ROYAL METEOROLOGICAL SOCIETY.—49, Cromwell-road, South Kensington, London, S.W. 7. Discussion on "The Formation of Cyclones," opened by Professor V. Bjerknes. 5.15 p.m.

TUESDAY, MAY 13TH.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, London, S.W. 1. Annual general meeting of corporate members. 6 p.m.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "The Geology and Oil Measures of South-East Persia," by Mr. R. K. Richardson. 5.30 p.m.

MANCHESTER GEOLOGICAL AND MINING SOCIETY.—Queen's Chambers, 5, John Dalton-street, Manchester. Paper, "Reinforced Concrete in Collieries, with special reference to Road Construction," by Mr. J. Drummond Paton. 4 p.m.

WEDNESDAY, MAY 14TH.

INSTITUTION OF RAILWAY SIGNAL ENGINEERS.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. Discussion, "Mechanical and Electrical Detection." 6.30 p.m.

INSTITUTION OF SANITARY ENGINEERS.—Caxton Hall, Westminster, London, S.W. 1. Paper, "Some Physico-chemical Factors in Water and Sewage Purification," by Dr. E. K. Rideal. 7.30 p.m.

RADIO SOCIETY OF GREAT BRITAIN.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. Discussion, "Some Suggested Lines for Experimental Research," by Mr. C. G. Blake. 6 p.m.

ROYAL SOCIETY.—Burlington House, Piccadilly, London, W.1. Conversazione. 8.30 p.m.

THURSDAY, MAY 15TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: GRADUATES' SECTION.—Watergate House, Adelphi, London, W.C. 2. Paper "Solo Motor Cycle Design from the User's Point of View," by Messrs. D. S. D. Williams and H. G. Harris. 7.30 p.m.

INSTITUTION OF MINING AND METALLURGY.—Geological Society's Rooms, Burlington House, Piccadilly, London, W. 1. Papers:—"Carbonaceous Matter at Porcupine": (1) "Its Geological Occurrence," by Mr. J. Mackintosh Bell; (2) "Its Metallurgy," by Mr. A. Dorfman; "The Constitution of Copper Mattes," by Mr. F. H. Edwards; "A Microscopic Examination of the Insizwa Sulphide Deposits," by Mr. T. C. Phemister. 5.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Lecture, "Atmospheric Interference in Wireless Telegraphy," I., by Dr. E. V. Appleton. 5.15 p.m.

THURSDAY TO SATURDAY, MAY 15TH TO 17TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Irish District meetings in Belfast and Dublin.

FRIDAY, MAY 16TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Third Report of the Steam Nozzles Research Committee. 6 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "The Stained Glass of York Minster," by the Very Rev. W. Foxley Norris. 9 p.m.

SATURDAY, MAY 17TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Visit to the works of Howard and Bullough, Limited, Accrington. 3.15 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Sessions House, Maidstone. South-Eastern District meeting. 11 a.m.

SATURDAY, MAY 24TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Southern District meeting at Abingdon. 10.30 a.m.

THURSDAY, MAY 29TH.

ROYAL AUTOMOBILE CLUB.—The annual general meeting of the R.A.C. will be held at the Club on Thursday, May 29th, at 2.30 p.m.

THURSDAY TO SATURDAY, MAY 29TH TO 31ST.

INSTITUTE OF TRANSPORT.—Congress at Bristol. For programme, see page 478.

MONDAY, JUNE 2ND.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Royal Automobile Club, Pall Mall, London, S.W. 1. Dinner to celebrate Colonel Crompton's eightieth birthday. 7.30 p.m.